



The NEHU Journal

Vol. XIX, No. 2 (July –December), 2021

NEHU

ISSN. 0972 - 8406



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Editorial

Dear Researchers and Readers

Dear Researchers and Readers

With life limping back to normalcy, academics has returned to classrooms and laboratories and expecting the days to continue the same without any further disruption.

With academic interactions in offline mode, the new volume of the journal contains articles on varied subjects and blends articles of multidisciplinary nature drawn from Life Sciences, Human & Environmental Sciences, Law and Social Sciences.

The volume begins with a article on **“Partition and the early history of the refugee vs immigrant discourse for Assam (1947- 1950)”** by Binayak Dutta. The author presents debates on the relationship between partition and citizenship in post colonial India which has heated up as a prelude and aftermath of the passage of the Citizenship (Amendment) Act, 2019. Scholars engaging with the Act seems to focus primarily on the the politics of the political parties, their ideology and the attempts by the Government to overcome the conundrum of the National Register of Citizenship exercise in Assam. This article attempts to locate itself in understanding the relationship between Partition of India and citizenship and trace this early history.

Suktilang Majaw, H. Alfred Thanglorsang and Ungshungmi Horam in their paper **“Ameliorative effect of *Oxalis acuminata* Wall. Ex Benth. leaves aqueous extract on high fat diet induced alterations in mice”** present an investigation on the effect of *Oxalis acuminata* Wall. Ex Benth. leaves aqueous extract on alterations associated with high fat diet (HFD) in mice. HFD fed mice are considered as an appropriate model for obesity study and the findings provide evidences for the ameliorative effect of OLE against alterations observed in HFD fed mice.

The paper on **“Parameters of forest usage among the Khasi of Meghalaya”** by Rekha M. Shangpliang presents the significance of nature in shaping the culture and ways of life of people in a given habitat which has been a widely recognized subject of social scientists in recent times. Living in harmony with nature has

been an integral part of traditional and indigenous societies. To them nature has often been exemplified as “cultural space” expressed through its invocation and representation in myths, ethics, beliefs and folk ways.

C. Ramhnehzauva in his paper “**Domestic water sources and water storage tanks among different income group in Aizawl city**” presents a study on Water being under-supplied in the study area. The fact that water supply is almost wholly in the realm of the public sector verifies that governments are unable to provide adequate water supplies. It is characterised by poor water supply infrastructure. Services are generally poor for all sectors of society, but for poorer sector, conditions are worst because of their perceived inability to pay house connection fees.

Arigo R. Sangma and SR Joshi in their review “**Areca nut: Traditional processing, uses and products potential of the husk**” discuss about areca nut (*Areca catechu* L.) consumed in many parts of the world including India and its husk considered as an agro-waste that can be used for obtaining different kinds of products. The present review is an effort to compile the available information on areca nut and its husks with respect to its uses as composite material, enzyme production, litter, compost, mushroom cultivation and in removal of dyes.

The article on “**Contamination by fake news distributions during the Covid pandemic**” by Nitesh Sharma encompasses a new challenge of fake news as a malice that has the power to wreak havoc on society. This malice is the spread of fake news and hoaxes that has almost taken pace post imposition of the nationwide lockdown by the Indian Government. In addition to social media, numerous websites, and apps, mainstream media such as newspapers, television, and radio also contribute to the proliferation of fake news. Despite the extensive coverage of the pandemic, there is some information that represents the outbreak, its severity, spread, and other false claims.

Baibhav Raj Barbaruah, Rajat Roy, Upashna Chettri and SR Joshi in their research work “**Currency notes in circulation can be potential sources of transmissible diseases**” present findings on currency as the primary medium for exchange of goods and services and makes it a hub for microorganism to thrive. This paper highlights the presence of multitude of bacteria which have the potential to cause diseases as well as being antibiotic resistant which get circulated through currency

notes.

In the paper “ **Topotecan and (22S)-Budesonide as potential Drug candidates against ORF3a in SARS-CoV-2 virus**” by Rik Ganguly, Shashi Kumar Yadav and Atanu Bhattacharjee present computational study on SARS-CoV-2 RNA virus covered in a spiked glycoprotein envelope which acts as a causative agent for COVID-19. SARS-CoV-2 ORF3 gene encodes a novel structural protein ORF3a whose actual mechanism and functions are still unclear. The study involves in finding an effective drug that can bind to the active pocket of ORF3a protein to reduce the viral load. The authors have used in silico techniques to screen FDA-approved drugs.

I take this opportunity to thank the contributors for their submissions and the reviewers for their promptness in providing valuable comments. Suggestions and cooperation of the editorial members have always been a source of guidance and strength.

My sincere appeal to the scholars to submit/continue submitting manuscript(s) for publication in future issues of The NEHU Journal.

Prof. S.R. Joshi
Editor

Partition and the early history of the refugee vs immigrant discourse for Assam (1947- 1950)

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Abstract

In recent years, debates on the relationship between partition and citizenship in post colonial India have heated up as a prelude and aftermath of the passage of the Citizenship (Amendment) Act, 2019. Scholars engaging with the Act seems to focus primarily on the politics of the political parties, their ideology and the attempts by the Government to overcome the conundrum of the National Register of Citizenship exercise in Assam. It is pertinent to reflect that few scholars have traced the citizenship debate to the initial years of independent India or the debates taking place in the Constituent Assembly. While there can be no denial of the relevance of engaging with the immediate politics of the Act, the long history of the citizenship question in post-colonial India cannot be ignored in the present context of the Citizenship (Amendment) Act, 2019. This article attempts to locate itself in understanding the relationship between Partition of India and citizenship and trace this early history.

Keywords: Partition, Citizenship, Refugee, Immigrant, Immigration, Border, Violence.

Introduction

Engagement with partition and refugee-hood was part of a larger commitment of the Indian leaders engaging with post-colonial national reconstruction shared across political spectrum in India since the years immediate to independence reflecting itself in the assertions of leaders such as Mahatma Gandhi, Jawaharlal Nehru and Sardar Vallabhbhai Patel (They are not Foreigners...They are citizens, 1980) and also in the deliberations of the Provisional Parliament after independence. Politics and the experiences of the people at the grassroots manifested in a violent partition of the subcontinent had a deep impact on the construction of citizenship in post-colonial India, a process that has entered the construction of citizenship over more than seven decades in Assam reaching a recent crescendo during the just concluded process for enrolment of the National Register of Citizens, 2015-2019.

Unburdening a divided legacy

While interprovincial borders of colonial era became international boundaries, perceptions about population migration also underwent a change. Inter-provincial migration which was easy and mostly unrestricted became restricted by the legal regimes. Though there was no restriction of people from East Pakistan to Assam in the initial years after independence, gradually the provincial governments and the Government of India (Constituent Assembly Debate, 1948) began to discourage migration of Muslims from Pakistan to India between 1948 and 1950 (West Pakistan (Control) Ordinance, 1948). The correspondences between Jawaharlal Nehru and leaders such as Sardar Patel who pointed out that there was a rising discontent among Indians in general and refugees in particular about the inflow of Muslims into India from Pakistan (Durga Das and Sardar Patel's Correspondence 1945-50, 1973). The East Pakistan situation was very critical as there was a steady exodus of Hindus who constituted 31 percent of the total population in 1947 and were reduced to 22 percent in 1951 (Barkat *et al.*, 2008). As people migrated, the entire subcontinent was in flux, especially in the east and the west of India bordering the two wings of Pakistan. One of the epicentres of intense activity in the east was Assam which shared more than 885 km. border with East Pakistan. Nehru, in his letter to the Chief Ministers on 1st April, 1948 was quick to point out that, "the exodus of non-Muslims from East Bengal continues. We are naturally as much bound to help these refugees as any from western Pakistan" (Parthasarathi, 1985).

But despite utmost attempts from India, the conditions continued to deteriorate and hostilities between the displaced Hindu refugees, coming from East Bengal and the Muslim returnees from Pakistan had obviously grown despite the best efforts of the Prime Minister to downplay the differences between the Hindu refugees and the Muslims, who were popularly perceived as illegal migrants and fortune seekers. As partition introduced the 'foreigners' dimension into politics the debate only became more intense and anxiety ridden. The situation became critical as the initial trickle of people wanting to migrate to India from East Pakistan became a flood by 1949 as the political atmosphere in East Pakistan became increasingly hostile to the minority communities across the border. The hostile situation on the ground for the East Pakistani Hindu population was as much reflected in official correspondence between the ministers of the central government and other leaders of Congress party, who were located in the provinces, sharing a border with East Pakistan, in the local press and also as such in debates of the Constituent Assemblies of India and Pakistan.

The Home Minister, Sardar Patel also outlined the grim situation when he pointed out that,

...the problem of East Bengal is difficult. There are about 15 million Hindus there. They are weak and soft. The people of the Punjab were different. They were strong, they could assert themselves and fight.

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The people of East Bengal are in a sad plight. Nobody wants to leave his own hearth and home without any reason. After all, in India they would have to starve. It is because of conditions in which they live there are bad that they migrate to India... (Chopra, 2004).

Though the Punjab situation had stabilized by 1948 as, in the language of Sardar Patel, “there was not a single Hindu or Sikh left in West Pakistan” indicating that the population transfer or exchange was more or less completed, in the east, it was a different scenario. This increasing hostility faced by the non-Muslims in particular in East Pakistan was at the core of public and political debates informing the refugee versus immigrant dichotomy emerging in the formative post-colonial years and reflected in the legal debates on citizenship in India through the deliberations and decisions of the Constituent Assembly, a representative body of 385 members representing both the British Indian provinces and the Indian princely states (Misra, 1990)

Fleshing the difference

One of the earliest debates to have a detailed engagement with citizenship, the impact of partition and the demographic upheavals of East Pakistan and the future of non-Muslim ‘displaced/refugees’ migrating from East Bengal/ East Pakistan to Assam resonated in the deliberations on the proposed electoral roll envisaged for the first general elections after independence in the arguments and proposals of Jawaharlal Nehru himself. Nehru, who was in favour of holding elections “as early as possible in the year 1950” and argued in favour of facilitating the obvious incorporation of ‘refugees’ into the electoral roll and therefore by obvious implication, into ‘citizenship’ pointed out in his reply to the demand by RohiniKumar Choudhuri, a member representing a general seat from Assam, whether the rights of refugees should be protected even if by “special provision” as against ‘vague migrants who may come in’ (Constituent Assembly Debates, 1949) Nehru pointed out that, “it was intended that they should vote...” (Constituent Assembly Debates, 1949). This position is the first major assertion of the distinction that the Indian state had always maintained a pro-refugee position in post-independence post-partition. It was in view of the difficult situation that, Nehru and other leaders of the Constituent Assembly, while speaking on the issue proposed that, “...a person who has migrated into a province or Acceding state on account of disturbances or fear of disturbances in his former place of residence shall be entitled to be included in the electoral roll of a constituency if he files a declaration of his intention to reside permanently in that constituency” (Constituent Assembly Debates, 1949). Though the debate in the Constituent Assembly was primarily restricted to the necessity of the filing of a declaration by the refugees who would come to India after 31st March 1948, on the question of refugee rights to secure a place in the voters

list of independent India, there was no dispute. Though this provision on the gestation period prior to the refugee securing the status of the voter, was also adopted after much opposition and incorporated into the statute after much debates, there was a consensus that the refugee rights to secure voter-ship in independent India was on board. Seven months later when the Constituent Assembly met to debate on citizenship, it was Rohini Kumar Choudhury, again, who championed the citizenship claims of the refugees coming to Assam, more so the partition victims. Rohini Kumar Chaudhuri who represented a general seat from Assam in the Constituent Assembly was aware of the difficulties posed by partition on the lives of the non-Muslims in East Pakistan and its impact on India in general and Assam in particular. Its significant that in pressing his amendments to the draft of Articles, 5 and 6 he demanded citizenship for those persons who migrated from East Bengal to Assam,

because they found things impossible for them there....Can anyone imagine for a moment that there is no fear of disturbance in the minds of these East Bengal people who had come over to West Bengal and Assam?...Has that sense of security now after a period of two years been enhanced by the fact that Pakistan has been converted into a theocratic state?...The fear is latent in the minds of everybody. The moment any Hindu or a person of any minority community raises a protest against any action which is taken there, disturbances would immediately follow.... I want citizenship rights to this class of people who have originally belonged to Sylhet in the province of Assam, who long before the partition, have come to the Assam Valley as citizen 'of that province and are staying in the present province of Assam... I want to make it perfectly clear that I want citizenship rights for those people of East Bengal who had gone over to West Bengal or Assam out of fear of disturbance in the future or from the sense of insecurity and – also for those people who have come over from Sylhet, who at the time of coming had no fear of disturbance or anything of that kind, but who on account of fear of disturbances now have decided to live here (Constituent Assembly Debates, 1949b).

But even at that critical moment of his exposition on the future of citizenship in India and Assam, the Choudhury did not lose sight of the obvious distinction between the refugee and the immigrants as he opposed the inclusion of Bengali Muslim immigrants into the new citizenship register by declaring that,

“I would exclude those persons who came only three years ago, who set up the civil disobedience movement forcibly occupied land which was not meant for them and forced the benevolent and benign Government to have recourse to the military to keep peace in the province. ...I desire

to exclude those persons who surreptitiously introduced themselves into my province and who now having mixed themselves with their own brethren, now desire to have citizenship rights...I desire to exclude these people because they had not long ago set up the struggle for Pakistan, they had not long ago taken an active part in compelling the politicians in India to agree for partition...I only want that those classes of persons whom I have mentioned should be included and should get citizenship rights and those classes of persons whom I want to exclude should not get the right of citizenship..." (Constituent Assembly Debates, 1949b).

For Choudhury, the only Assamese Hindu representative from Assam who spoke on citizenship rights, his presentation was seminal as it was supported also by Mr. Dharanidhar Basu-Matari representing the Tribal people of Assam and Mr. Nibaran Chandra Laskar, representing the Bengali Scheduled Castes from Assam, (Constituent Assembly Debates, 1949b) representatives of three most important components of non-Muslim society in Assam. It was a spectacular joint front, unprecedented in history and steeped in the tenuous communal history of Assam, especially the anti-immigrant sentiments of the Assamese middle class and attempts by them to reconcile this history with post-colonial reality. It is important to remember that the Congress ministry in Assam which came to office after the elections of 1946 had launched a vigorous anti-immigration drive and had also had to resort to forceful eviction drives and counter measures against the Civil Disobedience that was launched by the Muslim League in Assam in March, 1947 (National Archives of India, nd), a fact which resonated in the assertions of Choudhury.

When the Constitution of India came into force in 1950, the sentiments of the Assembly clearly reflected itself in within the Constitutional framework accommodating the interests of the displaced/refugees in post-colonial India, though the term 'refugee' exactly did not find a mention in the bulky constitution that came to govern the nation-state. But between 1947 and 1950, as India was giving itself the Constitution, East-Pakistan was in the throes of a violent conflagration which was singularly targeting the non-Muslim population. A summary of the incidents presented in a memorandum submitted by one of the Hindu members of parliament in Pakistan to the prime minister, Nurul Amin in December, 1949 drew his attention to

"indiscriminate requisitioning of Hindu houses, godowns, shops, educational institutions and other immovable properties all over East Pakistan. It pointed out that in Dacca alone 3 thousand Hindu houses had been requisitioned. The licence of Hindus holding fire arms were cancelled and the arms were seized. Large number of houses and lands throughout Pakistan were forcibly occupied by Muslims. Temples were desecrated.

Large number of reports of crimes against Hindu women were brought to the notice of the authorities but were ignored. Forced conversions and forced marriages after abduction were also mentioned. Large number of dacoities during which attacks on women had taken place had become a feature of rural life in East Bengal. Muslim mobs on the pretexts of keeping an eye over disloyal non-Muslims raided Hindu houses. In the rural areas forcible removal of crops, plucking of fruits from trees, cutting of bamboos and catching fish from the tanks belonging to Hindus had become most common. The attitude of the Government and the police towards these complaints from Hindus was complete indifferent and some district magistrates openly preached against the Hindus. The Minority Boards agreed upon by the Neogy- Mohammad Pact were either not brought into existence or were not allowed to function. Local Boards and Municipalities where Hindus held the majority seats were arbitrarily suspended.

In February 1950, there was a repetition of the pattern of Calcutta killing in East Pakistan. Unfortunately, this was widespread. The atrocities which began in August 1949 all over East Pakistan continued almost for a period of 36 months.

These incidents led to a fresh wave of migration and thousands of Hindus poured into West Bengal, Assam and Tripura” (Jurists’ Commission Report, 1965).

The number of displaced almost touched about half a million people by April, 1950. But even in such a grave situation, while people belonging to the minority communities in East Pakistan poured into India, a large number of Muslim economic opportunity seekers, who belonged to the majority, who otherwise had no political threat to their lives, took advantage of the political flux, also slipped into India. It was a scenario to which the Government of Assam drew the attention of the central government since 1948 (See Shri Gopalaswami’s statement, 1950) and the Government of India was not prepared to overlook as it not only aggravated the economic pressures on partitioned India and Assam (Indian Parliamentary Debates, 1950) but also created a serious security scenario forcing the Government of India to promulgate an ordinance to prohibit the entry of such Muslim migrants from East Pakistan into Assam and India. While the non-Muslim migrants were classified as ‘displaced’ or referred to as ‘refugees’ the latter were clearly identified as ‘undesirable immigrants’ in official discourse, including the Ordinance that the central government promulgated to overcome the grave scenario, pending the passage of a bill in the provisional Parliament to that effect. Though the arguments came from diverse ideological backgrounds and different readings of history, this classificatory difference between ‘displaced’/refugees and illegal immigrants continued to dominate the debates on migration/immigration cutting across ideological lines.

Partition and the early history of the refugee vs immigrant discourse for Assam (1947- 1950)

Many public leaders of post-colonial India including Guruji Golwalkar believed that, "...the Pakistani Muslims have been infiltrating into... Assam surreptitiously and the local Muslims are sheltering them... a conspiracy to make Assam into a Muslim majority province so that it would automatically fall into the lap of Pakistan," (Golwalkar, 1966) the Government of the day and many Congress leaders, including those from Assam thought no different, as they also closed ranks to support the legal course adopted by the Government to overcome the challenge as, "... the matter was urgent and it became necessary to request the Governor-General to issue an ordinance..." (Indian Parliamentary Debates, 1950) which was promulgated on 6th January 1950.

But when the Government brought in the bill to regularize the ordinance through the Undesirable Immigrants (Expulsion from Assam) Bill 1950 to the Parliament to "provide for the expulsion from Assam of undesirable immigrants", (Indian Parliamentary Debates, 1950) as distinguished from "persons who on account of disturbances or disorder in Pakistan or any other country have come to take refuge in Assam..." (Indian Parliamentary Debates, 1950) almost all the members of parliament dominated by the Congress party joined ranks. Almost all the members speaking on the bill especially those from Assam, prominent being Shri Rohini Kumar Choudhury, Shri Surendranath Buragohain, Shri Dev Kanta Barooah, and Shri Kuladhar Chaliha supported the bill and desired its passage into an Act. There is no doubt that the Bill, on becoming an act with the title Illegal Immigrants (Expulsion from Assam) Act, 1950 promulgated on the 1st of March, 1950, contributed to create a legal foundation for a differentiation between Non-Muslim and Muslim migrants into Assam based on a difference in understanding the causes of migration distinguished on religious lines, the focus on violence or apprehensions about it and its diverse manifestations on the non-Muslims in East Pakistan and its resultant insecurities and apprehensions. Members were extremely concerned with the fate of the migrants who had come to Assam from areas which formed part of East Pakistan as the situation was not as favourable for the refugees in East Pakistan. Rohini Choudhuri, a senior Congress leader from Assam who was articulating the unique predicaments of the citizenship issue for the Bengali refugees from Sylhet at the Constituent Assembly and his colleague from Assam, Mr. Surendranath Buragohain again took to the floor to assert the difference between the refugees and immigrants. Rohini Choudhuri led the debate by asking the Minister,

"to make it clear by a clause that the word 'immigrant' in the Bill does not include the refugees who have come to Assam... But I may say that for a single refugee who has come to Assam three times that number have come from Eastern Pakistan who cannot by any means be called refugee... who have come in for economical reasons or for the reasons of exploitation" (Indian

Parliamentary Debates, 1950).

Considering the location of Assam as the third partitioned province of colonial India, it was perhaps important to make the difference considering that the minority Hindus from Sylhet would naturally want to come to India, more so to Assam as the displaced. It was not to any surprise that Shrimati Sucheta Kripalani was quick to point out that “it is very natural that these people, Hindus who were formerly people of Assam and who are now citizens of East Bengal, when they are persecuted they would try to enter our land”(Indian Parliamentary Debates, 1950). Perhaps the most vociferous was Mr. Deb Kanta Barooah, also from Assam, who was even more categorical to point out that,

“although the dictionary meaning of the word ‘immigrant’ is anybody who comes from one country to another, in this particular case the word ‘immigrant’ means only Pakistani Muslim immigrants from Eastern Pakistan and does not include the refugees of whom a census was separately taken in Assam. We have learnt from Shri Rohini Kumar Choudhury that 1,20,000 displaced persons, who left East Bengal for fear of persecution have come to Assam. We must draw a line between these two types of people—People of Pakistani origin and nationality who owe no loyalty to our country and to our State, and people who for their love of India and patriotism have been persecuted in Pakistan and have taken shelter in Assam” (Indian Parliamentary Debates, 1950).

These interventions from the debate led the Government of India to insert a proviso into one of the sections of the bill that sought to make the distinction between persecuted displaced minority community person/refugee East Pakistan and illegal/ undesirable migrants from East Pakistan who had ‘subsequently come to reside in Assam’. The mover of the bill, Gopalaswami Ayyangar, in his reply was firm in pointing out that, the sword of eviction and the clause of ‘undesirability’ under the Act, when promulgated, would not apply to people, “who subsequent to the partition of the subcontinent on the 15th of August, 1947, have migrated in fear to Assam, because of disturbance in Pakistan or their fear of their being badly dealt with in Pakistan” (Indian Parliamentary Debates, 1950). Therefore, when the Act came to be promulgated, the proviso to Section 2(b) read,

‘Provided that nothing in this section shall apply to any person who on account of civil disturbances or the fear of such disturbances in any area now forming part of Pakistan has been displaced from or has left his place of residence in such area and who has been subsequently residing in Assam.’

Though most Indian leaders including Jawaharlal Nehru and Sardar Patel were generally opposed to the migration and settlement of refugees from East Pakistan in India, on principle, trying to talk to their east Pakistani counterparts (Neogy and Gulam Mohammad

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Agreement, 1948) or on many occasions making insensitive statements about East Bengal refugees (Sardar Patel: Muslims and Refugees, 2004),¹ with the hope that these refugees would not migrate to India or even if they had migrated, they would go back to Pakistan, they also fell in line with the dominant pro-refugee and anti-immigrant sentiments of their political compatriots turned fellow Members of Parliament.

With the aggravation of violence on non-Muslims in East Pakistan and against Muslims in some provinces of India led the Prime Ministers of India and Pakistan to meet in April, 1950 forced the Government to bring a motion in Parliament to discuss the critical situation in East Bengal in Parliament. Probably for the first time, Jawaharlal Nehru, initiating a discussion on the motion Re: Bengal Situation on the 7th of August, 1950, stood in Parliament to point out that,

my opinion is that the Hindu minority in East Bengal feels – it is an important fact how they feel- insecure and, therefore they cannot settle down, you might say and there is a tendency to come away or even if they remain, they do not know how long they will remain. That is a fact....(The Indian Parliamentary Debates Part II, 1950)

and further pointing out that,

...10 million people, nearly a crore of Hindus are still in East Pakistan. It is a very large number. It is true that a large number of middle-class people have come over; it is also true that specially after these February – March disturbances, people like teachers came over. Schools were closed; educational institutions ceased to function, so that the normal life of the minority community was completely upset there. There were children without schools and school masters without children and so on...(The Indian Parliamentary Debates Part II, 1950).

But that was only the tip of the iceberg. As the Hindu middle class left their homes in East Pakistan, the brunt of violence fell on the lower classes and the Dalits who were still holding on to their homes which came to be detailed in the resignation letter of the Dalit leader Jogendranath Mandal of East Pakistan from his post of Cabinet Minister of Pakistan and subsequent statement on his migration to India who pointed out that,

“neither the East Bengal Government nor the Muslim League leaders were really earnest in the matter of implementation of the Delhi Agreement...Commission of thefts and dacoities even with murder is going on as merrily as before. Thana officers seldom record half the complaints made by Hindus. That the abduction and rape of Hindu girls has been reduced to certain extent is due only to the fact that there is no caste Hindu girl between the ages of 12 and 30 living in East Bengal at present. The few depressed class girls who live in rural areas with their parents are

not even spared by Muslim goondas. I have received information about a number of incidents of rape of scheduled caste girls by Muslims. Full payment is seldom made by Muslim buyers for the price of jute and other agricultural commodities sold by Hindus in major market places. As a matter of fact, there is no operation of law, justice or fair play in Pakistan, so far as Hindus are concerned” (Jogendra Nath Mandal’s Resignation, 1950).

The situation in East Pakistan was not a secret and the Government of India was aware of the situation on the ground across the border as the Prime minister in a statement on the exodus of people from East Pakistan between 1947 and 1949 had pointed out, in March, 1950, that, “1,600,000 people had thus been forced to come away from East Bengal to West Bengal during the period ending on 31st December, 1949” (Statement in Parliament., 1950) While Nehru was keen to present a sober and a balanced picture of the background for the incessant migration scenario in the subcontinent by 15th November, 1950 when Nehru rose to speak on the President’s address to Parliament and pointed to the refugee situation he assured the members of Parliament that,

...the hon. Member referred to the question of citizenship. There is no doubt, of course, that those displaced persons who have come to settle in India are bound to have their citizenship. If the law is inadequate in this respect, the law should be changed (Jawaharlal Nehru’s Speeches, 1954).

The Government of the day had indeed come a long way since April of the same year when the Prime Minister was steadfast in advocating the repatriation of the refugees from East Pakistan and was reticent to ensure their rehabilitation in India.

In Lieu of a conclusion

While the country has crossed seventy-four years since the partition of India, the wounds of partition and the antagonisms of an earlier era have not healed. Though the attempts of the post-colonial government has been to move beyond the predicaments of partition of India in 1947 it is something that we are yet to reconcile with. The creation of Pakistan and the partition of India and Assam continued to fester the lives of the people like a phantom through the predicaments of citizenship in northeast India even after the creation of Bangladesh, as most recent reports and researches emerging from Bangladesh itself, would inform us. While partition of India may have been an event many years past for the other parts of the country, for the north-eastern region and its people, it is a live issue that we are still coming to terms with. It is in this sense that re-visitation of debates surrounding the question of migration, settlement and citizenship remain relevant to this day.

Notes

Mahatma Gandhi's post prayer speech on the 21st July, 1947, *Amrita Bazar Patrika*, Calcutta, 23rd July, 1947 in *No! They are not Foreigners...They are citizens*, Fariadi, Silchar, 1980, p, xi.

Jawaharlal Nehru's message on the 15th of August, 1947, *Amrita Bazar Patrika*, Calcutta, 15th of August, 1947 in *No! They are not Foreigners...They are citizens*, Fariadi, Silchar, 1980, p, xii.

Sardar Vallabhbhai Patel's speech on the 15th of August, 1947, *Amrita Bazar Patrika*, Calcutta, 15th of August, 1947 in *No! They are not Foreigners...They are citizens*, Fariadi, Silchar, 1980, p, xiii.

See interventions on the citizenship provision by Sardar Bhopinder Singh Mann in the Constituent Assembly Debate, dated 12th August, 1948. For details on the introduction of the Permit System since 19th July, 1948 in Feroz Meharuddin vs. Sub-Divisional Officer and Ors., AIR 1961 M.P. 110.

Sardar Patel observed on 18th December 1948 that "In East Bengal there were still one and half crore of Hindus. They were unlike the Punjabis or Sindhis who could fight back the Muslims. Nor could they come to India and quarrel with the Government. Bengalees were not strong: they only knew how to weep." P.N. Chopra and Prabha Chopra (ed) *Sardar Patel: Muslims and Refugees*, Konarak Publishers, Delhi, 2004. p. 273.

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Constituent Assembly Debates dated 12th August, 1949b see intervention by Rohini Kumar Chaudhuri, pp. 413-415.

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- See Shri Gopalaswami's statement on the Undesirable Immigrants (Expulsion from Assam) Bill, 1950 in Indian Parliamentary Debates, 8th February, 1950, Vol.-I, pp. 315.
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Ameliorative effect of *Olax acuminata* Wall. Ex Benth. leaves aqueous extract on high fat diet induced alterations in mice

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Abstract

*The present study investigates the effect of *Olax acuminata* Wall. Ex Benth. leaves aqueous extract on alterations associated with high fat diet (HFD) in mice. HFD fed mice are considered as an appropriate model for obesity study. In this study, mice were fed with HFD for 45d (20g/mice/day) period. *O. acuminata* leaves extract (OLE; 50 mg/kg b.w.)/orlistat (ORL; 10 mg/kg b.w.) was administered intraperitoneally for alternate days to HFD mice from 29d to 45d. Administration of OLE significantly improved the liver/kidney weight in mice fed with HFD. Further, treatment with OLE/ORL improved the enzyme activities i.e., hexokinase, phosphoenolpyruvate carboxykinase and acetyl coA carboxylase in liver/kidney including the lipid profile in HFD fed mice. These findings provide evidences for the ameliorative effect of OLE against alterations observed in HFD fed mice. However, ORL-treated mice showed higher significant effect therefore, increasing the OLE dose could further improve its effect which needs further investigation.*

Keywords: High fat diet, kidney, liver, mice, *Olax acuminata*, orlistat

Introduction

Obesity is a disease that results from chronic energy imbalance and excessive accumulation of body fat. Atleast 2.8 million people are dying each year as a result of obesity (World health Organisation, June 2021). Obesity can lead to various metabolic complications such as insulin resistance, fatty liver and kidney diseases contributing to major causes of morbidity and mortality globally (Jiang *et al.*, 2016). Diet is considered as one of the major contributors to obesity (Higa *et al.*, 2014) and high fat diets (HFD) are commonly used for obesity studies in animals (Choi *et al.*, 2016; Bortolin *et al.*, 2018). In previous studies, increasing dietary fats have been shown to affect the levels of enzymes involved in carbohydrate and lipid metabolism in different tissues (Brooks and Lampi, 1996; Kume *et al.*, 2007). HFD is also reported to affect the serum lipid profile which modulates lipid metabolism (Aguilar *et al.*, 2011; Kang, 2012).

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The current anti-obesity drugs often have severe adverse effects. Antiobesity drugs such as rimonabant increases the incidence of psychiatric side effects, sibutramine increases blood pressure and orlistat has gastrointestinal side effects (Padwal and Majumdar, 2007; Palacios-Martinez *et al.*, 2013; Blasio *et al.*, 2014; Krentz *et al.*, 2016). Therefore, researchers are focusing on the natural therapies in combating obesity. Herbal medicines are being used for weight control and for the treatment of obesity (Sethi, 2011). Various plant extracts have been reported to have antiobesity properties in HFD-induced obese mice (Ku *et al.*, 2012; Noh *et al.*, 2013; Li *et al.*, 2016; Liu *et al.*, 2017; Kim *et al.*, 2019; Liu *et al.*, 2019; Sheng *et al.*, 2019).

In this paper, we have investigated the effect of a medicinal plant, *Olex acuminata* Wall. Ex Benth. (Family: Olacaceae) on HFD fed mice and compared its effect with a known antiobesity drug, orlistat (ORL). *O. acuminata* (local name *dieng-tyrut*) is a shrub found in the Khasi Hills of Meghalaya and its leaves are edible (Sawian *et al.*, 2007). *O. acuminata* aqueous-methanolic leaves extract is reported to possess both hypoglycemic and an antihyperglycemic effects (Rynjah *et al.*, 2016). The essential oils found in *O. accuminata* have been shown to exhibit antioxidant properties (Chetia *et al.*, 2014).

Materials and Methods

Chemicals

Adenosine triphosphate (ATP), nicotinamide adenine dinucleotide phosphate, cholic acid, cholesterol, malate dehydrogenase, glucose-6-phosphate, pyruvate kinase, lactate dehydrogenase were purchased from Himedia Laboratories Pvt. Ltd., Mumbai, India. Nicotinamide adenine dinucleotide hydrogen, phosphoenolpyruvate, uridine 5'-diphosphoglucose solution was purchased from Sisco Research Laboratory Pvt. Ltd., Mumbai, India. Whatmann filter paper No.1 was procured from GE healthcare Life Sciences, Maidstone, UK, 2-deoxy-D-Glucose, from Sigma Co.,USA and coconut oil from Marico Ltd., Puducherry, India.

Preparation of plant extract

Leaves of *O. acuminata* (Voucher no. 4975) were collected from Pomshutia, East Khasi Hills located in Meghalaya, India. Leaves of *O. acuminata* were dried at 37°C and then powdered. Then, 100g of powdered leaves were mixed with 1000ml of distilled water for 2 h at room temperature. The mixture was filtered and the solution was evaporated to dryness using rotary evaporator (Stuart, Sttaffordshire, UK) followed by lyophiliser (Svanvac cool safe, Industry).

Yield percentage of plant extract

The yield percentage (%) for *O. acuminata* leaves aqueous extract (OLE) was calculated as per the formula given below:

$$\text{Yield percentage(\%)} = \frac{\text{Weight of extract}}{\text{Weight of plant material}} \times 100$$

Experimental model

Swiss albino mice were purchased from Pasteur Institute, Shillong. Mice were placed in suspended bracket cages housed in a room kept under controlled conditions with temperature maintained at 27-28°C with free access to food and water. The clearance certificate for research project was approved by the Institutional Ethics Committee (IEC) guidelines of NEHU, Shillong, Meghalaya, India.

Preparation of HFD feed

The preparation of high fat diet (HFD) was prepared by mixing 2% cholesterol, 1% cholic acid, 25% coconut oil and 72% grounded standard pellet diet (Nampurath *et al.*, 2008).

Administration of OLE/ORL

Mice were divided into 4 groups: (i) Normal mice fed standard food pellet, (ii) HFD control mice treated with 2% ethanol, (iii) HFD mice treated with *O. acuminata* leaves extract (OLE; 50 mg/kg b.w.) (iv) HFD mice treated with orlistat (ORL; 10 mg/kg b.w.). HFD were fed at 20g/mice/day for 45d period (Biswas *et al.*, 2014). OLE/ORL was administered intraperitoneally for alternate days to HFD mice from 29d to 45d.

Determination of relative organ to body weight

The liver and kidney were carefully dissected out and weighed. The relative organ to body weight was represented as relative organ weight to body weight (g/g b.w.) of an individual mouse.

Enzyme assay

Activities of hexokinase, HK (Braithwaite *et al.*, 1995), phosphoenolpyruvate carboxykinase, PEPCK (Petrescu *et al.*, 1979) and acetyl Co A carboxylase, ACC (Numa *et al.*, 1971) for homogenized liver and kidney were assayed using UV-Vis spectrophotometer (CECIL CE, Cambridge, UK). Total protein was estimated as per Bradford's method using a spectrophotometer (1976).

Lipid profile measurement

Serum total cholesterol and High-density lipoprotein (HDL) cholesterol levels were measured spectrophotometrically using an assay kit (AUTOSPAN® CHOD-PAP Enzymatic End Point). Serum total triglyceride level was estimated according to the

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protocol provided in the assay kit (AUTOSPAN® Liquid Gold Triglyceride GPO-PAP, End Point Assay).

Statistical analysis

The data on the effect of OLE in HFD fed mice was entered in the Microsoft® Excel spreadsheet, where it was organized and then exported to statistical software Graphpad prism for analysis. One-way ANOVA was used to test the significance among the normal control mice, HFD control mice, OLE-treated HFD mice and ORL-treated HFD mice. The values $p < 0.05^*$, $p < 0.01^{**}$, $p < 0.001^{***}$ were considered as statistically significant.

Results and Discussion

Yield percentage of OLE

In the present study, the yield percentage of *O. acuminata* aqueous leaves extract was found to be $7.81\% \pm 0.77$. Earlier report showed that the yield percentage of aqueous methanolic extract of *O. acuminata* was 9.50% (Rynjah *et al.*, 2016) suggesting that the extraction yields can vary depending upon the solvent as indicated elsewhere (Nguyen *et al.*, 2022).

Effect of OLE on liver and kidney weight of HFD mice

To evaluate the effect of HFD on tissues, we measured the weight of liver and kidney after the experimental period. Our result showed significant increased in liver to bodyweight ratio and in kidney to body weight ratio in mice receiving HFD when compared to the normal control mice (Table 1). This is in support with many studies which demonstrated increased liver and kidney weight in HFD fed animal models (de Castro *et al.*, 2013; Ji *et al.*, 2017; Kim *et al.*, 2018; Feng *et al.*, 2019). HFD affects the energy balance (Oosterman *et al.*, 2015) leading to renal lipid accumulation due to insulin resistance which has been linked to declined renal function (Jiang *et al.*, 2005; Guebre-Egziabher *et al.*, 2013; Muller *et al.*, 2019). Excessive lipid accumulation observed in HFD fed animal model (Kanwal *et al.*, 2020) could have been one of the major reason for increased liver weight. Administration of extract caused significant reduction in the liver and kidney weight of HFD fed mice. The effect of the extract was as effective as that of the reference drug, ORL.

Table 1: Effect of *O. acuminata* leaves aqueous extract on liver and kidney weight (g/g b.w.) in HFD fed mice. All data are represented as mean \pm SEM where n=3, *p<0.05, **p<0.01 and ***p<0.001 were considered significant.

Treatment group	Liver weight (g/g b.w.)	Kidney weight (g/g b.w.)
Normal control	0.0457 \pm 0.0002	0.0092 \pm 0.0002
High fat diet control (HFDC)	0.0677 \pm 0.0018 **	0.0115 \pm 0.0004 **
High fat diet treated with extract (50 mg/kg b.w.;OLE)	0.0597 \pm 0.0012 ***	0.0100 \pm 0.0000 **
High fat diet treated with Orlistat (10mg/kg b.w.; ORL)	0.0576 \pm 0.0013 **	0.0093 \pm 0.0003 *

Effect of OLE on HK activity of HFD mice

As shown in Table 2, The HK activity was significantly lowered in HFD control mice by 52.78% when compared to normal mice. In contrast, the HK activity in kidney was significantly increased by 53.19% in HFD control mice. HK is the first step enzyme involved in glycolysis pathway. HFD impairs glucose tolerance and hepatic insulin signaling (Peng *et al.*, 2012) thereby, hepatic HK being an insulin-dependent enzyme has been reported to be inactivated or inhibited (Ramesh *et al.*, 2017; Kim *et al.*, 2018). Kidney being insulin-independent for glucose uptake reflect its differences in their ability to metabolise glucose (Vidhya and Udayakumar, 2018) thus, could play a role in increased HK activity as observed in our study. Administration of extract significantly (**p<0.01) improved the HK activity in liver and kidney of HFD fed mice when compared to the HFD control mice. Treatment with ORL however, showed higher significant value (***p<0.01) in kidney in comparison to the OLE-treated HFD mice.

Effect of OLE on PEPCK activity of HFD mice

PEPCK catalyses the first committed step in gluconeogenesis, is thus a central player in glucose homeostasis. Significant increase (***p<0.001) in PEPCK activity was observed in liver and kidney of HFD control mice when compared to normal mice as shown in Table 2. Dysregulated glucose metabolism associated with increased gluconeogenesis and decreased glycolysis is reported to contribute to the onset of the insulin resistance (Muller *et al.*, 1997; Nordlie *et al.*, 1999). Administration of OLE markedly decreased PEPCK activity in liver (***p<0.001) and kidney (**p<0.01) of HFD fed mice as supported in previous study (Kwon and Choi, 2020). As observed in HK activity, treatment with ORL

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also resulted in more significant (**p<0.001) decreased enzyme activity in kidney in comparison to the OLE-treated HFD mice.

Effect of OLE on ACC activity of HFD mice

ACC is the key enzyme in fatty acid synthesis and plays a critical role in lipid metabolism. A significant increase (**p<0.001) in the ACC activity was observed in liver and kidney of HFD control mice when compared to normal mice (Table 2). Inhibition of ACC has been reported to improve insulin sensitivity in mice fed with HFD (Schreurs *et al.*, 2009). In our study, HFD mice administered with OLE showed decreased enzyme activity (**p<0.01) in liver and kidney of HFD fed mice which is in line with other studies (Naowaboot and Wannasiri, 2016; Kim *et al.*, 2018). Treatment with ORL markedly decreased (**p<0.001) the enzyme activity in liver and kidney of HFD fed mice.

Table 2: Effect of *Olex acuminata* (OLE) leaves aqueous extract on enzyme activities in liver and kidney of HFD fed mice. All data are represented as mean±SEM where n=3,*p<0.05, **p<0.01 and ***p<0.001 were considered significant. HK: Hexokinase; PEPCK: phosphoenolpyruvate carboxykinase; ACC: acetyl Co A carboxylase.

Treatment group	HK (U/mg protein)		PEPCK (U/mg protein)		ACC (U/mg protein)	
	Liver	Kidney	Liver	Kidney	Liver	Kidney
Normal control	0.0373 ± 0.0009	0.0147 ± 0.0004	0.0057 ± 0.0007	0.0051 ± 0.0001	0.0116 ± 0.0008	0.0114 ± 0.0006
High fat diet control (HFDC)	0.0176 ± 0.0005 ***	0.0313 ± 0.0024 ***	0.0157 ± 0.0018 ***	0.0109 ± 0.0007 ***	0.0270 ± 0.0017 ***	0.0247 ± 0.0016 ***
High fat diet treated with extract (50 mg/kg b.w.;OLE)	0.0283 ± 0.0026 **	0.0201 ± 0.0012 **	0.0083 ± 0.0003 ***	0.0077 ± 0.0003 **	0.0183 ± 0.0009 **	0.0141 ± 0.0021 **
High fat diet treated with Orlistat (10mg/kg b.w.; ORL)	0.0295 ± 0.0023 **	0.0183 ± 0.0003 ***	0.0044 ± 0.0002 ***	0.0055 ± 0.0002 ***	0.0153 ± 0.0005 ***	0.0100 ± 0.0009 ***

Effect of OLE on lipid profile of HFD fed mice

As shown in Table 3, serum total cholesterol and total triglyceride levels were significantly (**p<0.001) increased but the HDL cholesterol level was decreased in HFD control mice when compared to normal control mice. Compared to the high-fat diet-fed mice

however, the serum total cholesterol levels and serum triglycerides were significantly (** $p < 0.01$) reduced and the HDL cholesterol level was increased in the OLE-treated mice however, it was not found significant. Our data is supported by many studies involving plant extracts which improved the lipid profile when administered to HFD fed animal model (Kumar, 2013; Naowaboot and Wannasiri, 2016; Seyedan *et al.*, 2017; Wu *et al.*, 2020). However, in comparison to extract-treated HFD fed mice, ORL-treated mice showed more (** $p < 0.001$) significant effect in improving the lipid profiles.

Table 3: Effect of *Olax acuminata* (OLE) leaves extract on total cholesterol level of HFD fed mice. All data are represented as mean \pm SEM where $n=3$, * $p < 0.05$, ** $p < 0.01$ and *** $p < 0.001$ were considered significant. NS: non-significant; HDL: High density lipoprotein.

Treatment Group	Total Cholesterol (mg/dl)	Total Triglyceride (mg/dl)	HDL Cholesterol (mg/dl)
Normal control	81.42 \pm 2.4957	95.85 \pm 0.6513	52.57 \pm 2.4178
High fat diet control (HFDC)	238.04 \pm 4.8362 ***	154.93 \pm 8.0852 ***	27.13 \pm 2.8451 ***
High fat diet treated with extract (50 mg/kg b.w.; OLE)	209.94 \pm 4.1378 **	120.79 \pm 4.0001 **	34.68 \pm 1.2678 NS
High fat diet treated with Orlistat (10mg/kg b.w.; ORL)	93.91 \pm 2.0385 ***	102.76 \pm 1.0633 ***	48.27 \pm 0.3845 ***

Conclusion

This study revealed that at the dose of 50 mg/kg b.w. aqueous extract of *O.acuminata* showed ameliorative effect against the alterations induced in HFD fed mice. Although, the effect of the aqueous leaves extract of *O. acuminata* was not as significant as observed in ORL-treated HFD mice. Therefore, increasing the extract dose could improve its effect comparable to ORL which needs further investigation.

Acknowledgement

The authors acknowledges the research support by the Department of Biotechnology & Bioinformatics, North-Eastern Hill University, Shillong received through various grants which includes UGC-Non-plan (FA2/NP/Allocation/2018-19 dated 13.08.2018), UGC-

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SAP (F4-7/2016/DRS-I (SAP-II) dated 28.04.2016), DBT-M.Sc. Teaching program (102/IFD/DBT/SAN/2140/2006-07 dated 16.03.2017) and DST-FIST (SR/FSI/LSI-666/2016(C) dated 15.12.2017).

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Parameters of forest usage among the Khasi of Meghalaya

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Abstract

The significance of nature in shaping the culture and ways of life of people in a given habitat has been a widely recognized subject of social scientists in recent times. Living in harmony with nature has been an integral part of traditional and indigenous societies. To them nature has often been exemplified as “cultural space” expressed through its invocation and representation in myths, ethics, beliefs and folk ways. The natural wisdom of the tribes in particular has endowed the indigenous people with natural management skills that exemplify their deep sense of eco-consciousness. Nature has served them as an economic base sustaining their livelihood and supplementing their daily requirements for food, fodder, shelter and fuel by way of collecting NTFP (Non Timber Forest Products). The Khasi are a matrilineal tribe inhabiting the North Eastern region of India. The symbiotic relationship between the Khasi and their natural surrounding is evident in their deep rooted customs and traditions such as preserving sacred forests or Law Kyntang, their ancient tribal lore of folk medicine, use of forest produce for daily sustenance, livelihood strategies etc. However of late due to pressure of population, the development debate ,privatization of land, forest legislations and issues of the politics of environment ,this close affinity between the Khasi and nature has undergone severe strain .This paper is primarily focused on the different parameters of tradition bound linkages between the culture, economy and way of life of the Khasi with forest as a part and parcel of nature and at length aims to discuss the challenges and modern forces of development affecting man-nature relationship.

Keywords: Khasi, Matrilineal, Sacred Groves, Livelihood, Forest Legislations, Land alienation.

Introduction

The Khasi Hills are located in the northeastern corner of India in the middle of the Meghalaya plateau with East and West Garo Hills lying towards its West and Karbi Anglong District of Assam towards the East. The Khasis occupy a unique position both from ethnic and linguistic points of view among the congeries of the tribes inhabiting

the mountainous terrain of India's North East. There are numerous interpretations of the word "Khasi". Hamlet Bareh suggests that the term "Khasi" means "born of the mother"; "*kha*" means "born of" and "*si*" refers to "ancient mother", thus bringing out the matrilineal character of the Khasis who trace their descent from the mother. (Bareh, 1985) The Khasi follow the principles of matrilineal descent where ancestral property is passed from the mother to the daughter, preferably the youngest daughter or the "*khadduh*". The matrilineal Khasis of Meghalaya believe in the ideology-"*Long jait na ka kynthet*" which means "From the woman sprang the clan". This ideology is so deeply rooted in the Khasi ethos that it has brought to light the role of women in perpetuating the clan from one generation to another. Descent line in a Khasi family is reckoned only from the mother's clan or '*kur*' as a result of which the children belong to the descent group of the mother.

The Khasi Concept of Forest

The Khasis have a deep rooted affinity with nature. The earth which is symbolized as 'mother' or 'meiramew' is looked upon as the caretaker of all the natural resources. According to H.O Mawrie, '*U Khasi U im bad ka mariang bad ka mariang ka im ha u*'. (Mawrie, 1981). This resounding declaration which when translated means "A Khasi lives with nature and nature lives with him" bears testimony to the fact that nature with all its bounty shares a harmonious relationship with the Khasis. Thus, forest holds an important place in the social, economic and religious life of the Khasis. For a Khasi the forest or '*ki khlaw ki btap*' as they call it, is a well loved home, a game sanctuary and also an abode of worship all rolled into one, around which his social, cultural and religious activities revolve. It would be pertinent to discuss here the parameters of forest usage in various aspects of Khasi life and culture.

Parameters of Forest Usage Among The Khasi: -

The usages of forest and forest products by the Khasis can be enumerated under the following categories:

1. Forest Legends and Folklore:

The Khasi folklore and legends, "*Khanatang bad Puriskam*" have played a very important role in shaping their ethno-cultural traits and values. Most of them are woven around the various forces of nature such as the hills and vales, rocks and caves, the flora and fauna. These elements of nature are personified in the legends as the mother and son, husband and wife and friend and foe according to their natural behaviours, their love, hate, jealousy, pride and vanity which are projected out before the listeners with the sole purpose of teaching moral and spiritual values. A well-known Khasi legend centres on the belief in "*U Diengier*", a giant tree on the top of a hill. The tree signifies the foundation of human

society within the eco-system. According to this legend, God planted 'ka diengiei' as a sign of the covenant of coherent existence of all creatures. But man in his foolish greed decided to cut down the tree of social covenant believing that he would see the light of wealth and prosperity, but instead his heart was filled with deep sorrow and remorse. He turned to '*ka Lei-Synshar*' (God's executive attribute) and begged for her forgiveness and promised before her that in place of ka diengiei which he had cut down he would set up '*Ki Law Kyntang*' (sacred groves) all over the land. The Khasis believe that a tiger is always guarding the *Law Kyntang* and it is the same tiger of yore that licked the diengiei in an attempt to save it from wanton destruction. This tiger is known as *U ryngkew U basa* or *U la ryngku*. This folktale throws ample light on the attitude and perception of the ancient Khasis towards tree and forest. They considered forest as the home of Gods and evil spirits, as something dreadful and looked them with a sense of awe and reverence.

2. Forest for musical Instruments:

The Khasi love dances, music and songs. From time immemorial, the Khasi have their own indigenous musical instruments, which consists of different kinds of drums, pipes, harps and cymbals. The musical instruments are locally made which bring to light the artistic skill of the Khasi. Among the different types of musical instrument, the most prominent are:

1. The Drums (*Ka Ksing*) :

- (a) '*Ka bom ka nakra bad tasar*' or the big drum.
- (b) '*Ka ksing bom*' or '*sing nakra*' or the smaller drum.
- (c) '*Ka ksing kynthei*' or the female drum.
- (d) '*Ka Ksing shynrang*' or the male drum.
- (e) '*Ka padiah bad ka ksing dingphong*' are smaller drums.

2. Stringed Instruments: Some of the stringed instruments are '*ka duitara*', '*Ka marynthing*', '*ka maryngod*' all of which are similar to the Hindustani Sitar which originated in India.

3. Blowing Instruments

- (a) '*Ka tangmuri ne Ka Muhuri*'
- (b) '*Ka Sharati*'
- (c) '*Ka besli*'
- (d) '*Ka mieng*'
- (e) '*Ka shawiang*'

(f) '*Ka tanglod*'

(g) '*Ka put sla*'

All these blowing instruments are made of bamboo except '*Ka put sla*'. Khasi drums are nearly always made of wood, not of metal or earthenware. '*Ka Padiah*' is a small drum with a handle made of wood while '*Ka Ksing*' is a cylindrically shaped drum and '*Ka nakra*' is a large kettledrum made of wood having the head covered with deerskin. '*Ka duitara*' is a guitar with *muga* silk strings, which is played with a little wooden key held in the hand. '*Ka tangmuri*' is a wooden pipe, which is played like a flageolet. The Khasis also play a Jew's harp (*ka mieng*), which is made of bamboo (Gurdon, 1975).

Thus, we find that the Khasis make an extensive use of bamboo and wood in their indigenous musical instruments.

3. Forest for Weaving and Dyeing:

The Khasis learnt how to depict various designs and colours in their clothing from nature. They are well acquainted with the art of weaving. According to Gurdon, many weaver families were known to have settled in Khyrwang villages of Synteng, Mynso and Sutnga. The Khyrwangs weave special pattern of cotton and silk cloth with stripped red and white. Before the British came, this industry was considerable. The Census conducted before 1907 gives the number of weavers in Khasi Jaintia as 533. The Khasis of Bhoi weave cotton and dye it with leaves of a plant called '*U Nob*' for black colour. They also boil the coloured thread in the leaves of a tree called '*Ka Lakhynroh*' (*Symplocaceae*; *Symplocus glomerata*) to make the colour a lasting one. They also use the bark of the tree called '*Dieng Pyrshit*' (*Eurya accuminata latifolia*) for dying thread. It gives a yellow colour (Gurdon, 1975).

There is a village called Umrasun in Ri-Bhoi district where the local villagers still continue the art of weaving their clothes with various designs and colours depicting symbols such as trees, bamboos, flowers, animals and birds with threads already dyed in various colours obtained from lac or leaves and barks of trees. These special clothes they make are called '*Phali*'.

Rearing of Eri Silk worm (*khñiang ryndia*) is an ancient art known to Khasis. They use a tree called '*Ka Lakynjor*' (*Bignonaceae*; *Oxylum indica*) as feed for the silkworm. They also cultivate '*Larynda*' (castor plant) for this purpose (Khongsit, 1988).

The Khasis also carry out lac culture by rearing insect on the '*Sohphyrnu* tree'. They tie the insects on this tree where they eat and grow up and increase in number. They collect lac in the month of October. Another type of tree called '*Ka Jrisim*' in Bhoi is

also used for rearing lac insect. Lac is cultured till today in Nongstoin areas in a village known as 'Umsohpieng'. They use the tree named '*dieng Risim*' in these areas. During the lean season the lac cultivators preserve lac insect on the trees called '*U toh Laha*' (*Popilianeae*; *Cajanus indica*) as seed until the time for cultivation arrives. This tree is small about 8 to 10 ft. tall with green barks and grows well in Bhoi. During winter, the insects are kept on the '*Toh Laha Tree*' then are transferred to Diengsohphyrnu or Jrisim or Diengrai for cultivation.

A particular tree called '*Ka Dieng Sohtung*' (*Aralia* Sp.; *Araliaceae*) has black coloured leaves and the Khasis of yore used these leaves for dying threads for making the '*jymphong*' or sleeveless coat worn by men.

Besides these trees the following species of trees are also used as dyes:

- (a) *Ka Nuli* (*Strobilanthes secundus*) – brilliant black colour
- (b) *Ka Pantaro* (*Strobilanthes*) – brilliant red colour
- (c) *Ka Dieng Mitang* – red colour of different shades.

4. Forest for Weaponry:

The weapons of the Khasis are swords, spears, bows and arrows and a circular shield, which was used formerly for purposes of defence. It is surprising that in the Khasi sword, the handle is never made of wood or bone or of anything except iron or steel, the result being that the sword is most awkward to hold and could never have been of much use as a weapon of offence.

The Khasi weapon par excellence is the bow. Archery may be styled as the Khasi national game. The Khasi bow '*Ka ryntieh*' is made of bamboo and is used mostly for hunting purposes. The bowstring is of split bamboo and the bamboos that are used are of 3 types: (a) '*U spit*', (b) '*U shken*' and (4) '*U siej-lieh*'.

The Khasi arrow '*Khnam*' are generally of two types: (a) The plain-headed (*sop*); (b) The barbed-headed (*ki pliang*). Both types are made of bamboo. The feathers of birds like vultures, geese, cranes, cormorants and hornbills are used for arrows.

5. Forest in Khasi Rituals and Ceremonies:

Rituals abound in Khasi religion and culture. In the words of H.O. Mawrie, "*Ka Kolshor bad ka niam ki long kiba la ngam ha ki thied snam jong ngi kum ka jaitbynriew bad ban bret ia ki ka long kumba patar da lade ia lade.*" ("Rituals are a part and parcel of our culture. They have embedded their roots deep down in our flesh and blood and to think of mankind to throw away either of them is to tear oneself apart.") There are rituals

pertaining to three important stages in one's life:

- (1) Naming ceremony (*ka jer ka thoh*)
- (2) Marriage (*poikha-poiman*)
- (3) Death (*niam iap*)

(a). Naming Ceremony

The following are some instances of the use of forest products during the birth ceremony:

- a) When the child is born, a sharp splinter of bamboo cuts the umbilical cord. No knife can be used on this occasion.
- b) When the umbilical cord, after being tied falls off, a ritual is performed by offering worship to certain water deities '*Ka blei sam-um*' and also to forest spirit '*U 'suid bri*' or '*U 'suid khlaw*'.
- c) For the naming ceremony, the pounded rice flour is placed on a bamboo winnower called '*U prah*.'
- d) A plantain leaf is used to place five pieces of '*Kha piah*' or dried fish.
- e) Liquor is placed in a gourd (*klong*).

(b). Marriage Ceremony

A simple wedding ceremony of the Khasi would include the exchange of distilled liquor from two gourds (*klong*) which are mixed together. The priest then says a prayer of blessing over the couple and pours the entire liquor on to the three '*khapiah*' or dry fish. These are then placed in a container and preserved over the hearth.

(c). Death Ceremony

The following instances of the use of forest products are evident in death ceremonies of the Khasis:

- a) The dead body is laid on a mat (*japung*) made of bamboo.
- b) A small bamboo basket (*ka shang*) is hung up over the head of the corpse.
- c) Sometimes the body is placed in a coffin, which is laid on a bamboo bier (*ka krong*).
- d) As the funeral party sets out to the bone repository (*mawshieng*), one person in front strews a line of route with leaves of the tree known as '*dieng shit*'. If any stream is to be crossed, a rough bridge is made of branches and grass. This trail of leaves and the bridges are intended to guide the spirit of the deceased to the cairn.

6. Forest for Food

A large variety of Non-Timber-Forest Products (NTFP) are used by the Khasis to supplement their daily food requirements. These include tubers, fruits, roots, wild edible plants, mushroom, bamboo shoot, creepers etc. The Khasis have a variety of wild plants which they use as their daily food and it is a natural wisdom of the Khasis to be able to differentiate between different wild plants. They can also distinguish between edible and poisonous mushrooms. The Khasis know of a wide variety of mushrooms, each of which they call by name. A trip into the woods and forests to collect vegetables and mushrooms is something they love and do regularly (Mawrie, 2001)

It is also interesting to note that the Khasis generally use the prefix ‘*Ja*’ to name the wild variety of edible plants that are found in the woods. The reason for this could be that ‘*Ja*’ which literally means ‘rice’ is the staple food of the Khasis and so the use of these edible plants with the prefix ‘*Ja*’ was a supplement to rice specially amongst the poorer section of the people. Khongsit, who made an in depth study on the various types and uses of forest produce with the prefix ‘*Ja*’ gives a list of 113 species of such plants and herbs. This list is given in Appendix-I for reference.

7. Forests as Sacred Abodes

Preservation of forests as sacred groves has been existent since time immemorial amongst the Khasis. People are mostly governed by their belief systems in conserving these forests. The existence of “*U Ryngkew U Basa*” or “the guardian spirit” in these forests is a belief that has existed amongst the Khasis since time immemorial. The ‘guardian spirit’, according to them, resides in the forest and takes care of the village community and protects them from sickness, pain, invasion by enemies, etc. Therefore, destroying or cutting of trees, grass etc. from these groves is considered to be against the wish of *U Ryngkew U Basa* and, therefore, people are afraid of these spirits (Tiwari *et al.*, 1999).

“*Law Kyntang*” as they are generally known are also known by various names such as “*Law Lyngdoh*” or “*Law Niam*”. These forests are set aside for religious purposes and are managed by the Lyngdoh (a religious priest) or any other person to whom the religious ceremonies for the particular locality are entrusted. Till today, these sacred groves are held in high esteem and every now and then religious ceremonies including worship of forest deities, dances and rituals are regularly performed, by the ‘*Lyngdoh*’ together with the villagers inside the grove. Mention may be made of the sacred grove at Pahampdem village located at Ri Bhoi district which is popularly known by the local people as ‘*U Lum Mawker*’ or ‘*U Lum Umphar*’. The grove is the biggest recorded sacred grove in the state with an area of 900 ha.

8. Forest for Medicine

The Khasis are known for their unique knowledge about plants wealth and herbals drugs in curing diseases. The origin of Khasi system of medicine is not known, as Khasi folklore and legend are silent about its origin. But the psychological, social and cultural contribution to this system is very prominent.

Khasi land tenure system and forest management

‘Land’ and ‘Forest’ are both the natural endowments of nature on humankind. They have both played a historical role in the social, economic and cultural life of human communities through the centuries and one cannot undermine the importance of land and forest both as a resource and as property. As a valuable natural resource, land and forest represent the principal forms of wealth, are a symbol of social status and a constant source of economic and political power. However they have to be dealt as separate entities.

Land locally known as “*Ri*” by the Khasis has a deep attachment to their pattern of social organization and permeates every aspect of their socio – economic life. Land to the Khasis is a “gift of nature” that belongs to the community, therefore access to land not ensures economic security for the individual, but control over it symbolizes territorial integrity for the community as a whole (Nongbri, 2003). There are three categories of land in the Khasi Hills, viz., Community Land known as *Ri Raid* Land, Privately owned land called *Ri Kynti* Land and Government land.

I. *Ri Raid* Land (Community land)

Ri Raid Land is Community Land which is managed and controlled by the concerned community. Every member of the community has the right of use and occupancy of the *Ri Raid* land without payment of land revenue. The community may be a village or a group of villages. No person has proprietary, heritable or transferable rights over such land. He has only the right of use and occupancy, and such rights revert to the community when the person ceases to occupy or use the land for a period of three years or more. The only way in which a person can inherit land or obtain transferable rights over such land is by making permanent improvements on the land in the form of permanent buildings or cultivation of permanent crops and plant like fruit trees or cultivation. But these rights lapse if he abandons the land over a long period.

II. *Ri Kynti* (Private Land)

‘*Kynti*’ means ‘absolute possession’. Therefore, *Ri Kynti* lands are private lands which have been acquired by a man or woman individually, or in the case of a woman, inherited from her mother. Such lands must entirely be distinguished from lands of the

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clan. Colonel Gurdon notes that privately held lands “may be sub-divided into *Ri-Kur* or lands which are property of the clan, *Ri-Kynti*, family or acquired land property”. The clan lands, originally when the population was sparse, were owned by families but as the members of the family increased and a clan was formed out of the increasing number of families sprung from a common ancestress, the lands became the property of the clan instead of the family. Such clan lands are properly demarcated by boundary marks.

The Khasis also traditionally maintain Forest lands under various categories:

1. *Ri 'Law Kyntang, Ri 'Law Niam or Ri 'Law Lyngdoh*

These are forests in Raid Lands set apart for religious purposes, managed and controlled by the Raid or the village or in the case of the *Ri Law Lyngdoh* by the *Lyngdoh* (Priest) of the community.

2. *Ri 'Law Adong, Ri 'Law Sang, Ri 'Law Shnong*

These are village forests reserved by the villagers so that any member could obtain timber or firewood for personal needs or for use as water catchment areas._

3. *Ri 'Law Sumar*

Which belongs to the individual, clan or the village who had first occupied and afforested then and maintains them thereafter.

Issues Before Us:

With the change of time and tide over the last couple of centuries a tremendous change in the pattern of social life of the Khasi has taken place. The symbiotic relationship between man and nature that existed in the past has gradually given way to ecological stress and strain. Pressure of increased population, the development versus environment debate, advent of Christianity and flow of new culture and a borrowed world view, all have combined together to shatter the age-old economy, culture and tribal ethos of the Khasi. There has been an increased global interest in the diverse modes of human interaction with the larger ecological setting. Nature has been perceived as an inexhaustible domain of utility which was to be mastered, tamed and brought under man's power to satisfy his needs and minister to his happiness. It would therefore be pertinent to discuss some important issues that have affected the symbiotic relation between the Khasi and the forest.

1. Infringement of traditional rights over forest (Forest for Revenue)

The British policy on forest management was primarily oriented towards earning of revenue for the government. To meet that end the British established subsequent Forest Acts and regulations in 1865, 1868, Indian Forest Act, 1878, and 1927 which conferred the government with the right to constitute Reserved Forests on 'any forest land or waste land which is the property of the government'. These Acts not only debarred the local people from entering into and removing any forest produce from the reserved forests and protected forests but also permanently alienated them from the land itself. This had a far-reaching impact on the livelihood of the people in more than one way.

During the long period of British rule a considerable area of forested land of Khasi and Jaintia Hills were brought under ownership of the British Government, depriving the tribal forest dwellers of their natural rights. According to an estimate the land converted into Reserved and Protected forests in Khasi and Jaintia Hills amounted to 427.79 sq. km., which is certainly a large area for a small hill district. The British left India but the process of erosion in tribal rights that was started by the colonial rule did not stop with their departure. The Government of India adopted new National Forest Policy in 1952 and enacted revised instruments for management of national resources but the basic character ingrained in the Indian Forest Act, 1878 and 1927 continued to remain in the Indian forest laws. While new concepts of forest for environment and biodiversity were brought into the forest policies the poor people whose livelihood depended entirely on forests were completely lost sight of.

The Forest (Conservation) Act, 1980, which is the major legislation currently followed by all forest departments of the country has three main objectives – to check deforestation, to prevent diversion of forest land for non-forest purposes and, to enforce compulsory afforestation in lieu of forest land diverted. The Act thus, provides stringent measures for protection of forest from being reduced in size but at the same time it deprives the forest dwellers of their age-old rights enjoyed by them by prohibiting them raising of minor crops in the forest fringe areas. What is unfortunate is that, this Act is silent about creating conditions for alternative livelihood opportunities to the forest dependents that have been refrained from cultivating in fallow forest lands.

The Wild Life (Protection) Act, 1972 and Amended Act 1991 which seek strengthening of conservation of flora and fauna and prohibiting extraction of wild plants, animals and birds, puts a complete ban on collecting orchids/wild flowers and medicinal herbs from the forests for the purpose of local consumption and sell. There are great number of people - florists and herb dealers who live on these professions in Khasi and Jaintia Hills and the forest department is so far liberal in enforcement of this act on the ground

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that similar forest products are also available in private or community forests which are existent in large number in this part of the country.

Unlike many other states in the North East region, Meghalaya has vast areas of forested land owned by private individuals/ clans or communities which are controlled and regulated by the Autonomous District Councils according to their Acts and rules. In order to bring these forests under the jurisdiction of the state forest laws and rules the Government of Meghalaya introduced Meghalaya Forest Regulation (Application and Amendment) Act, 1973. This act is silent about the livelihood issues of lakhs of people engaged in these forest activities. If this Act is strictly enforced a large number of men/women and children who are directly dependent on collection of NTFPs (Non-timber forest Produce) will be thrown out of employment.

The United Khasi and Jaintia Hills Autonomous District (Management and control of forest) Act, 1958 which regulates the management and control of different classes of forests, prohibits the removal of forest produce including the minor forest products or NTFPs for the purpose of trade, from the Council's reserved forests, protected forests, community forests, Green Blocks etc. without permission from the competent authority. The Rules framed under this Act known as United Khasi and Jaintia Hills Autonomous District (Management and Control of Forests) Rules, 1960 provides elaborate procedure for removal and transit of forest produce from all categories of forests under the control and management of the District Council. This Act refuses to recognize the tribal rights and privileges of the community to enjoy the NTFPs of the forests in their own land. Although there exists a provision in the Rules for allowing the residents/ communities to collect non-timber forest produce for domestic purposes, the lessees to whom contracts for trading the NTFPs are given do not allow the villagers to remove the products which belong to them as per contract. Thus, the provision made in the rules which permits the villagers to use NTFPs for domestic purpose practically amounts to a naught. Large quantities of unprocessed broom-grass, tejpat, cane and bamboo etc. collected by the lessees find their ways to outside the state every year and the benefit of these natural resources goes to the pockets of the rich businessmen instead of the rural poor. Given the required financial and technical assistance, the Khasi village men and women who have traditional knowledge and skill to process the minor forest products into finished goods could have easily made their livelihood and at the same time helped boosting up the state's economy. The potentiality of the technique of value addition and marketing of various goods and domestic articles produced by village artisans have not been fully realized by the Government or the District Councils of Meghalaya.

2. Alienation of community land (Forest for Development)

As the implementation of Five Year Plans progressed in the country more lands were required for multifarious development purposes. Large areas of land were utilized for construction of roads, government buildings, extension of townships, industrial sites, stadiums and play grounds, air ports etc. These lands were, undoubtedly, acquired by government at the cost of agricultural or forest lands and major part of the land were *Ri-Raid* land that belonged to the people. This process of land acquisition caused large scale alienation of land from the people to the government or institutions rendering the poor cultivators landless.

Another form of land alienation visible in Khasi Hills is the conversion of community land (*Ri-Raid*) to private land (*Ri-Kynti*) by dubious means. Large areas of community land of Khasi Hills, especially in the Ri-Bhoi district and the southern border of Khasi Hills district are in the process of privatization by a section of people taking the advantage of the Khasi land tenure system which allows conversion of *Ri-Raid* land into *Ri-Kynti* by permanent plantation or other development of land. This process has been facilitated by Government sponsored schemes like establishment of Poultry Farm, Fish Farm, soil conservation or agricultural farm etc. In recent years the Joint Forest Management (JFM) scheme introduced by the Forest department is becoming an incentive for many Khasi individuals or clans to privatize community lands for building up private forest at the cost of government and the community. To quote Sanjeeva Kumar of the Ministry of Defence, Government of India- “despite its avowed claim to promote participation and conservation, in effect, JFM seems not only to extend State control to community space but also tends to deligitimise community” (Laine and Subba, 2012)

Conclusion:

In a country like India, where the vast majority of the rural households are dependent on the environment to meet their daily household needs, accessibility to natural resources seems to be a crucial problem in recent years. The issue of development in North East India has posed a challenge to planners since Independence. The region, predominantly inhabited by tribal people has its own opportunities and constraints, strengths and weaknesses, but many of the developmental initiatives in the region follow the national perspective of development where the environment was found to be the most potential resource for industrial and infrastructural development. This approach followed by the Government of India has directly affected the livelihood of the rural poor living in the North East. The tribals of the region depend on biomass or biomass-related products, which are mostly collected free from the immediate environment and they live within nothing other than a biomass-based subsistence economy. Another important problem that has surfaced in

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recent years is the alienation of land from the poor peasants due to possession of land by a few private owners and acquisition of land by the Government for various developmental works. As the resource demands for massive developmental programmes like roads, railways, industries, dams, airfields etc increased, it induced the Government to acquire vast areas of common lands, which was the main source of livelihood to the economically vulnerable and poor village folks. The basic need of the people in the North East depends on the fundamental concept of fair and just distribution of the natural resources which consists in the land and forest. However the Government has not entirely been successful to construct a development agenda in the interest of the rural poor. Despite its vitality and rapid rise to prominence the environmental movement against development has been unable to contribute creatively to major debates on development policy in contemporary India. Yet this is a debate that can be enriched only by balancing the sometimes conflicting objectives of economic growth and environmental protection.

List of plants and herbs which begin with the prefix ‘Ja’

(Source: S. Khongsit, 1999. *Kiba Ngi Khot Ja*, Shillong: Mrs. Sucila Khongngain, San Mer.)

- | | |
|--|---|
| 1) <i>Jakhria</i> (<i>Rhynchotechum ellipticum</i>) | 23) <i>Jakhain</i> (<i>Asteraceae; Pieris hieracioides</i>) |
| 2) <i>Jalyngiar</i> (<i>Sunchus arvensis</i>) | 24) <i>Jakhain pakham</i> (<i>Asteraceae Hypocharis</i>) |
| 3) <i>Jabuit</i> (<i>Acanthaceae; Phloganthus gamflei</i>) | 25) <i>Jarem</i> |
| 4) <i>Jalyngkthem saw</i> | 26) <i>Jarem saw</i> |
| 5) <i>Jalyngab lieh</i> (<i>Asteraceae; Senecio densiflorus</i>) | 27) <i>Jarem Shrieh</i> |
| 6) <i>Jalyngnap iong</i> (<i>Asteraceae; Inula cappa</i>) | 28) <i>Jahynwet</i> |
| 7) <i>Jaskei</i> | 29) <i>Jaralud</i> |
| 8) <i>Jamiaw</i> | 30) <i>Jali</i> |
| 9) <i>Jamiaw madan</i> | 31) <i>Jali Sniang</i> |
| 10) <i>Jathang</i> | 32) <i>Jali Krem</i> |
| 11) <i>Jatira</i> | 33) <i>Jali Pnar</i> |
| 12) <i>Jada dieng</i> | 34) <i>Jalynteng</i> |
| 13) <i>Jada hati</i> | 35) <i>Jalwain iong</i> |
| 14) <i>Jada shnong</i> | 36) <i>Japri</i> |
| 15) <i>Jathynrait rilum</i> | 37) <i>Jasniang</i> |
| 16) <i>Jathynrait riwar</i> | 38) <i>Jalyngiem</i> |
| 17) <i>Jasnian</i> | 39) <i>Jawer</i> |
| 18) <i>Jatung</i> | 40) <i>Janailar</i> |
| 19) <i>Jarasang</i> | 41) <i>Janailar Phud</i> |
| 20) <i>Jalynsiang</i> | 42) <i>Jalu</i> |
| 21) <i>Jatangniang</i> | 43) <i>Jarumshiah</i> (<i>Zehneria heterophylla</i>) |
| 22) <i>Jarain</i> | 44) <i>Jashun</i> (<i>Verbanaceae ruvela</i>) |
| | 45) <i>Jahynlaw</i> (<i>Viburnum caryocarpum</i>) |

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- | | |
|------------------------------|--|
| 46) <i>Jaiur</i> | 73) <i>Jalyngkhan</i> |
| 47) <i>Jaiur jhur</i> | 74) <i>Jaltham</i> |
| 48) <i>Jaiur khlam</i> | 75) <i>Jawieh raij</i> |
| 49) <i>Jalynnoh</i> | 76) <i>Jalieh dymmiew</i> |
| 50) <i>Jalynnoh skei</i> | 77) <i>Japu</i> |
| 51) <i>Jadaw</i> | 78) <i>Jakba</i> |
| 52) <i>Jalyngbien</i> | 79) <i>Jalong</i> |
| 53) <i>Japung</i> | 80) <i>Jamiyang</i> |
| 54) <i>Japung ktieh</i> | 81) <i>Jamiyang synrai (Ternstomoceae;
Camellia sp. F. Theaceae)</i> |
| 55) <i>Jaler</i> | 82) <i>Jashiah</i> |
| 56) <i>Jalmut</i> | 83) <i>Jaler lum</i> |
| 57) <i>Jalmut shniuh</i> | 84) <i>Jakhaw shoin</i> |
| 58) <i>Jamynsleh</i> | 85) <i>Jashun</i> |
| 59) <i>Jamyrwai</i> | 86) <i>Japri</i> |
| 60) <i>Ka Jamynrei</i> | 87) <i>Japri lum</i> |
| 61) <i>Jamyrwait rit sla</i> | 88) <i>Jajew shilliang</i> |
| 62) <i>Jamynrei ritbian</i> | 89) <i>Jajew shyrtong syiar</i> |
| 63) <i>Jajew skei</i> | 90) <i>Jajew saw</i> |
| 64) <i>Jakrai</i> | 91) <i>Jajer</i> |
| 65) <i>Jakrai Lum</i> | 92) <i>Jawieh</i> |
| 66) <i>Japongdung</i> | 93) <i>Jawieh</i> |
| 67) <i>Jalyniar prohsla</i> | 94) <i>Jaum</i> |
| 68) <i>Jamyrdoh</i> | 95) <i>Jalynnoh skei</i> |
| 69) <i>Jangew</i> | 96) <i>Jalbuit</i> |
| 70) <i>Jalkhan Lieh</i> | 97) <i>Ja Dieng Janai</i> |
| 71) <i>Jalkhan iong</i> | 98) <i>Jating</i> |
| 72) <i>Jalkhan heh</i> | 99) <i>Japiur</i> |

100) Japiur iong

101) Jasat

102) Jakhi iong

103) Jakhi shniuh

104) Jakhi rit

105) Jakhi nuli

106) Jaiing

107) Jalyngap sohriewlong

108) Jalyngap shymprong

109) Jarsang

110) Jasar

111) Janei

112) Jaryndem

113) Japang (Probila denticulate)

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Domestic water sources and water storage tanks among different income group in Aizawl city

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Abstract

Water is under-supplied in the study area. The fact that water supply is almost wholly in the realm of the public sector verifies that governments are unable to provide adequate water supplies. It is characterised by poor water supply infrastructure. Services are generally poor for all sectors of society, but for poorer sector, conditions are worst because of their perceived inability to pay house connection fees. Problems in water supply are especially severe. The level of service provided by a water supply system is a function of the price, quantity, quality, reliability, and convenience that it provides to the user. As a result, poor and rich are dissatisfied with their current water supply situation. However, it was observed that the rich are better off than the poor but not dramatically so as far as their satisfactory level is concerned. The characteristics of the water sources have a number of influences on choice of a water source. One characteristic of the water sources in the study area is that an individual piped connections facility is unreliable. Piped water connection into a house, a large sum of money is necessary to pay at a time. Secondly, there are different types of other water sources available to people. These different water sources are exposed to different kinds and degrees of contamination. This significantly influences both the extent to which this source of water is used and the way it is used.

Keywords: Income group, House connection, Tuikhur, Rainwater Harvesting

Introduction

The water needs of the hilly people for generations have been met by natural sources of water. Traditionally, Tuikhur (i.e., water seepages accumulated in artificially fabricated reservoirs and springs water collected in artificial tanks) on the hill slopes and collection of rainwater is used as the main source of drinking water in Aizawl. The affordability of water has a significant influence on the use of water and selection of water sources. The high cost of water may force households to use alternative sources of water of poorer quality that may present a greater risk to health. Many claim that the poor cannot pay for water and use this argument to imply that water need not be priced. However, this

argument is not based on reality. India's relatively poorer population does pay for water, both in a monetary sense and in terms of the effort required to obtain clean water (Bajpai and Bhandari, 2001).

Cost is a major factor in determining not only which source people choose for water but also the quantity of water used from it. However, if aggregate expenditure of un-served population by piped supply is studied, it frequently shows that the poor pay more for a poorer service (Lloyd *et al.*, 1991; Lewin *et al.*, 1996). However, cost is not a simple issue and involves to a substantial degree the relative value placed on different goods that can be purchased with available funds. Utility services often require the payment of large sums at one time; this clearly limits the potential for poor families to have house connection, as they may not be able to access these sums easily. It also involves a commitment to long-term patterns of payment that is contrary to income patterns. This is supported by the findings of a limited study in Jakarta dealing with survey methodologies in urban areas (McGranahan, 1997). Cost is a factor significantly influencing choice of a water source. It may partly explain why many people are willing to overcome both distance and congestion in order to collect water from outside their premises. Therefore, people within reach of the piped utility may collect water from house connections if they can afford to pay connection fees and monthly bills or be forced to fetch from a distant source (Tumwine, 2002).

The World Bank (2001) reports stated that 25 per cent of the urban population of Latin America and 60 per cent of the urban population of Africa are not connected to official utility networks and rely on alternative sources for their water supply. Low-income families that construct dwellings at the urban fringe far removed from main trunk lines, providing adequate supplies of safe water will remain one of the biggest urban challenges in coming decades (Howard and Bartram, 2005). In 2004, about 3.5 billion people worldwide (54 per cent of the global population) had access to piped water supply through house connections. Another 1.3 billion (20 per cent) had access to an improved water source through other means than house connections, including standpipes, water kiosks, protected springs and protected wells. Finally, more than 1 billion people (16 per cent) did not have access to an improved water source, meaning that they have to revert to unprotected wells or springs, canals, lakes or rivers to fetch water (World Bank, 2004).

The National Sample Survey Organisation (NSSO) data for 1998 indicates that about 70 per cent of urban and 18.7 per cent of the rural households had access to piped water supply (i.e. tap as the principal source) in India. Sixty-six per cent of urban households reported their principal source within their premises, while 32 per cent had within a distance of 0.2 km. Forty-one per cent had sole access to their principal source of drinking water, which

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means that 59 per cent were sharing a public source (NSSO, 1999).

Between 69 per cent and 74 per cent of India's rural population, take their drinking water from protected sources, leaving an un-served population of 26 per cent to 31 per cent. Between 91 per cent and 93 per cent of India's urban population, take their drinking water from protected sources (WHO and UNICEF, 2001). Economic condition and poverty rates are two important parameters that can significantly affect water use practices and use patterns, causing an overall increase in the demand for water in the domestic sector (WRI, 1995). Economic growth increases the demand for a wide variety of environmental services related to water (Pearce and Warford, 1993).

Study Area

Aizawl, the capital of Mizoram state, is situated in on the hillcrests, steep slopes and small valleys. It is located on a north-south elongated ridge, which acts as the main hill from which many small ridges and valleys are extending towards the east and west directions. The topography is highly undulating and rugged. The unique physical attributes of this rugged land are marked by extreme fragility and frequent landslides, limited land space, steep slopes and lack of accessibility. The city reveals a rapid and uncontrolled growth pattern with multi-storey settlements that has mushroomed unplanned on highly risk prone slopes. The altitude varies from 120 m to 1400 m above mean sea level. It falls between 23° 40' N to 23° 50' N latitudes and 92° 40' E to 92° 49' E longitudes. It covers an area of about 128.98 sq km, and as per Aizawl Municipal Corporation Report 2020, the population is 3,59,829 persons. There are a number of streams in and around Aizawl City, but none of them is dependable for providing adequate water. The only dependable source is river *Tlawng* located more than 1,000 m below the city.

Objectives of the Study

The objectives of the study are as follows:

- a. To study the households' economic determinant of water sources
- b. To probe economic determinant of households' water storage devices

Data Base and Methodology

The present study is based on the information obtained from primary and secondary sources.

- (i) Households' survey was carried out in 15 local councils out of 83 local councils of the study area during November – December 2018. This amounted to coverage of 18.07 per cent of the total local councils. The number of sample households selected from each of the sample local councils are 50 households, thus data was collected from 750 households. The sample households have a total population of

4,454 persons, children account for 32.88 per cent of the total. The mean value of households' size is 5.91, with a standard deviation of 0.90. About 69 percent of the sample households own their homes and 31 percent live in rented houses.

- (ii) The scheduled for household survey was designed to elicit information of households' economic status, type of water sources and type of water storage device use to meet their daily water needs. A simple index is created to represent the economic status of the households. Self-reported total monthly income is used as the measure of households' economic status. Hence, households were categorised into three different groups such as, high-income group (HIG), middle income group (MIG), and low-income group (LIG). A total monthly income less than the threshold level of Rs.20000 are designated as LIG, between Rs.20,000 to Rs.40,000 are designated as MIG and more than Rs.40,000 are considered as HIG. About 40.66 per cent belong to Low Income Group (LIG), 38.80 per cent to Middle Income Group (MIG), and 20.53 per cent to High Income Group (HIG). sample households own their homes and 31 per cent live in rented houses.
- (iii) The water sources have been classified into principal/main source of water and supplementary sources of water. Principal/main source of water refers to the water source that the households' has been obtaining the largest amount of water and the other sources is considered as supplementary sources of water supply. To conduct households' survey, few households have been identified because studying all the households in the sample local councils is usually impracticable in view of time, money involved, and other considerations. A stratified random sampling procedure was used to select local councils for the survey, i.e., number of population, percentage of individual piped water connections, and geographical location were taken into considerations to give an overall view of each corner of the study area. Households to be surveyed were selected based on random sampling method and it is believed that they are reasonably representative households in the study area.

Results and Discussion

Domestic Water Sources

Households' economy is one of the most significant determinant factors on choice of water sources. Most households are not using water from only one source but from multiple sources. The pattern of households' dependence on water sources varies with monthly income. It has been observed that among the low-income group (LIG) no household gets house connection, whereas 81.09 per cent of middle-income group (MIG) and 93.52 per cent of high-income group (HIG) have access to house connections (Table 1). It is important to note that households belonging to MIG and HIG without house connection at the time of survey are due to technical problem.

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All LIG families use *tuikhur* as their principal source of water supply, whereas 12.71 per cent of MIG and 1.30 per cent of HIG use *tuikhur* as their principal source of water supply. About 6.19 per cent of MIG and 5.18 per cent of HIG use rainwater harvesting as their principal source of water supply. Absence of LIG using rainwater harvesting as principal source of water reflect the limitation of physical and economical feasibility to make rainwater harvesting as their main source of domestic water supply for low economic family.

Among the LIG, cent percent have access to *Tuikhur*; 42.26 per cent have access to public taps; 91.48 per cent collect rainwater; 44.6 per cent use hand pumps and 14.1 per cent purchase water from tankers. Among the MIG, 81.07 per cent have house connections; 9.97 per cent have access to public taps; 73.89 per cent collect rainwater; 30.58 per cent use *tuikhur*; 5.16 per cent use hand pumps; 60.47 per cent buy water from tankers and 1.03 per cent have private dug wells. Among the HIG, 93.52 per cent have house connections; 1.94 per cent have access to public taps; 44.78 per cent collect rainwater; 5.18 per cent use *tuikhur*; 64.3 per cent purchase water from tankers and 1.3 per cent possess dug wells. It is important to note that no household from LIG has access to house connection and dug well, at the same time no household from HIG uses hand pump.

Table 1. Income Group-Wise Use of Water Sources (% of households)

Name of Water Sources	Low	Middle	High
<i>Tuikhur</i> + Rainwater	21.96		
<i>Tuikhur</i> + Rainwater + Public tap	20.32	04.12	
<i>Tuikhur</i> + Hand pump + Rainwater	24.30		
<i>Tuikhur</i> + Rainwater + Tanker	10.50	05.50	01.30
<i>Tuikhur</i> + Hand pump + Public tap	08.52		
<i>Tuikhur</i> + Hand pump + Public tap + Rainwater	10.80		
<i>Tuikhur</i> + Rainwater + Public tap + Tanker	02.62	01.03	
<i>Tuikhur</i> + Rainwater + Hand pump + Tanker	00.98	02.06	
Rainwater + Public tap + Tanker		04.12	01.94
Rainwater + <i>Tuikhur</i> + Tanker		01.37	03.24
Rainwater + <i>Tuikhur</i> + Public tap		00.70	
House connection		07.21	24.02
House connection + Tanker		13.05	31.20
House connection + Rainwater		13.40	09.74
House connection + Rainwater + Tanker		30.60	26.62
House connection + Rainwater + <i>Tuikhur</i>		09.96	00.64
House connection + <i>Tuikhur</i> + Hand pump		03.10	
House connection + <i>Tuikhur</i> + Tanker		02.74	
House connection + Rainwater + Dug Well		01.03	01.30

Among the users of only one source of water, 36.21 per cent belong to MIG and 63.79 per cent belong to HIG. In fact, the number of water sources access reflects the amount of water obtained from principal source of water. Of the users of two water sources, 32.37 per cent are from LIG, 37.19 per cent are from MIG and 30.43 per cent are from HIG. Subsequently, among the users of four water sources, the largest users 83.02 per cent are LIG, 16.98 per cent belong to MIG and no household from the HIG uses four sources of water. It means that lower the income, higher the number of water sources on which households depend.

As regards to the barriers of LIG from having piped supply connection, the survey revealed three major reasons. Firstly, most of the LIG families live in the local councils where the piped water facilities are limited. Secondly, utilities connection charges hinder the LIG from getting house connection. Thirdly, despite high connection fees water supply through house service connection is unreliable so that LIG families opt for other water sources. Fourthly, for new piped water connection, proof of land ownership is required but most of the LIG live in rented houses, hence they cannot produce the land ownership certificate resulting to disqualification from getting house connection.

The characteristics of the water sources have a number of influences on choice of a water source. Firstly, piped water connection into a house, a large sum of money is necessary to pay at a time. Secondly, there are different types of other water sources available to people. These different water sources are exposed to different kinds and degrees of contamination. This significantly influences both the extent to which this source of water is used and the way it is used. It can therefore be said that the vulnerability of unprotected sources influence water related practices. Thirdly, limitation in number of sources and supply of water from these sources influence water-collecting practices. Different water sources deliver less water during the dry season causing congestion at the sources during this time. The limited number of hand pumps and public taps create congestion at the sources. These characteristics clearly contribute to making water collection a time demanding activity, thus affecting the choice of water sources. These are a few of the factors that potentially influence peoples' choice of water source; but it is important to bear in mind that such choice is not stable or inflexible.

Water Storage Tanks

Storage of water within house premises is usually necessary to cope with an unreliable water supply. As one would expect, storage capacity and investment vary by income, the poor rely on portable, low-cost and low-capacity storage, whereas the high class use higher cost options. Besides, materials used for storing water also differ from household to household. In fact, the choice of material depends on local availability and affordability.

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The water storage tanks in the study area can be classified into three types as far as their placement is concerned, i.e., overhead storage tank, ground-level storage tank and under-ground storage tank. Most of the multi- storied buildings of RCC structure possess overhead tanks to provide uninterrupted water supply to its occupants.

People use three different types of water tanks, viz., cylindrical tank constructed with galvanised plain (GP) sheets, plastic tanks of cylindrical shape, and reinforced cement concrete (RCC) tanks constructed either in rectangular or square shape. The choice of tank capacity depends on a number of technical and economic considerations like space availability, cost of tank, labour for construction, cost of materials, and types of rainwater harvesting. The common vessels used for small-scale water storage include plastic bowls, buckets, tins, oil drums, empty food containers, etc. For storing larger quantities of water, large tank is required.

It is important to note that the water tanks capacity differs significantly by households' economic status. The low-income group's water tanks capacity ranges from 400 litres to about 7,500 litres and the average tank's capacity is calculated to 1,432.79 litres, with a standard deviation of 927.42. The tanks capacity of middle-income group's ranges from 3,000 litres to 22,000 litres and the average tanks capacity is estimated at 8,223.37 litres (S.D = 3043.92). Subsequently, the high income group's tanks capacity ranges from 5,000 litres to 25,000 litres and the average capacity is 7,853.90 litres with a standard deviation of 3506.73 (Table 2). The dispersion statistics (Standard Deviation) shows wide variations of tanks capacity in all the income groups. Interestingly, the middle-income group's tank capacity is higher than that of the high-income group, it indicates that rainwater harvesting through rooftop catchment is more suitable and popular among the middle-income group than the high-income group.

Table 2. Income Group-Wise Water Tank Capacity (in litres)

Income Group	N total	Mean	S.D	Min.	Med.	Max.
Low income	305	1432.79	927.42	400	1000	7500
Middle income	291	8223.37	3043.92	3000	8000	22000
High income	154	7853.9	3506.73	5000	7000	25000
Overall	750	5386	4146.37	400	6000	25000

Conclusion

The pattern of dependence on water sources varies with monthly income. Among the low-income group (LIG), no household has house connection, whereas 81.09 per cent of middle-income group (MIG) and 93.52 per cent of high-income group (HIG) have access to house connections. Households belonging to MIG and HIG without house connection

are those beyond reach of the network. It indicates that households' monthly income, which is a proxy for ability to pay, is a significant predictor for piped water in residence. All LIG families use *tuikhur* as their principal source of water supply, while 12.71 per cent of MIG and only 1.30 per cent of HIG use *tuikhur* as their principal source of water supply. Only MIG (6.19 per cent) and HIG (5.18 per cent) use rainwater harvesting as their principal source of water supply. As one would expect, water storage capacity and investment vary by income, the poor rely on portable, low-cost and low-capacity storage, whereas the high class use higher cost options. The average tanks capacity of low-income group is about 1,432.79 litres, whereas the average capacity of middle-income group is 8,223.37 litres and high-income group average tanks capacity is 7,853.90 litres.

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Areca nut: Traditional processing, uses and products potential of the husk

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Abstract

Areca nut (Areca catechu L.) belongs to the family Arecaceae. It is consumed in many parts of the world including India which is the largest producer in the world. Areca nut husk is considered as an agro-waste that can be used for obtaining different kinds of products. It contains compounds such as catechin, quercetin, phenolics, tannin and also has antimicrobial activity. The husk is used for enzyme production such as endoglucanase, manganese peroxidase and pectinase. It is also used for the production of xylose, ethanol and citric acid. Bio-adsorbent made from the husk can be used to remove different kinds of dye and chemicals such as brilliant green dye, methylene blue, phenol and Pb²⁺. The present review is an effort to compile the available information on areca nut and its husks with respect to its uses as composite material, enzyme production, litter, compost, mushroom cultivation and in removal of dyes.

Keywords: Areca nut, husks, enzymes, bioadsorbent, removal of waste.

Introduction

Areca nut (*Areca catechu* L.) belonging to the family Arecaceae is cultivated in 0.45 m ha in India with a production of 0.73 m tonnes in humid tropics and plains of South India, North-eastern region, and Andaman and Nicobar Islands (Anonymous, 2015). The plant is grown widely in North-eastern region. The fruit has a fibrous mesocarp, with endosperm deeply ruminated with a basal embryo. The husk constitutes about 60–80% of the total weight and volume of the fresh fruit. The husk fibre consisted of cellulose with different proportions of hemicellulose, lignin, pectin and protopectin (Ramachandra *et al.*, 2004). Areca nut husk fibre contains 53.2% cellulose, 32.98% hemicellulose and 7.2% lignin (Hassan *et al.*, 2010).

The North-eastern part of India is inhabited by ethnic tribes who are known to practise indigenous ways of livelihood. Their lifestyle is identified by distinct traditions and cultures among which consumption of areca nut along with betel leaf occupies an important place.

Traditional method of fermentation is an age-old practice in the region which not only enhances the taste and flavour of the processed products but also serves as a preservation strategy for foods, fruits, vegetables and meats. Along with foods and meats, the ethnic population is known to carry out fermentation of areca nut which is consumed locally. The areca nut are fermented for 3-5 months in soaking pits for enhancing the taste and flavour and also to preserve the nuts. In Assam, a pit of 2.5 feet is dug and leaflets of areca nut are placed surrounding the side and bottom of the pit. Some amount of cow dung is spread over it where the nuts are put, covered with jute bags along with some soil, and left for 3-4 months to ferment (Narzary *et al.*, 2016). In Meghalaya, 6 to 8ft depth pits are constructed and the areca nuts are filled in bamboo baskets/gunny bags and soaked for 3-5 months for fermentation (Nandula, 2014). The fermentative process which involves decomposition and transformation of organic substrate goes through different phases: a mesophilic phase, characterized by the proliferation of the microbiota, a thermophilic phase with a high rate of biodegradation, the growth of thermophilic organisms and the inhibition of non-thermotolerant organisms, and the final phase that includes a period of cooling, stabilization and maturation, characterized by the growth of mesophilic organisms and humification of the compost (Ryckeboer *et al.*, 2003). The time required for the maturation phase is a function of the substrate, environmental and operating conditions which can range from a few weeks to a year (Diaz *et al.*, 2002). Apart from the traditional fermentation and consumption of areca nut, it holds great promise in its utilization for deriving different products from its husk.

Biological activity of areca nut

Antioxidant activities of extracts from areca (*Areca catechu* L.) flower, husk and seed was studied and was reported that the seed has the best antioxidant properties and the highest DPPH radical scavenging activity and reducing power (Zhang *et al.*, 2019).

An *in vitro* study was done on the effect of areca nut extracts (ANE) based on the bactericidal activity of crevicular polymorphonuclear neutrophils (cPMNs) in healthy subjects and chronic periodontitis (CP) patients by taking their gingival crevicular fluid (GCF) samples that were pre-treated with two varieties of areca nut extract: ripe and tender which revealed its potential activity. Hydrogen peroxide (H_2O_2) assays was also performed and a decrease in bactericidal activity and H_2O_2 production of cPMNs were reported in both healthy subjects and patients which implies that the areca nut influences the cPMNs, thus reducing their efficiency at eliminating bacteria from the periodontal environment (Shrivastava *et al.*, 2020).

Song *et al.* (2017) did a study on the identification of endophytic fungi from areca nut by using tissue block culture method and isolated 47 endophytic fungal strains from the root,

leaf and flower of areca nut. Naveenkumar *et al.* (2012) isolated lignolytic and phosphate solubilizing fungi from areca nut husk waste. Estimation of lignolytic and phosphate solubilizing efficiency of isolated fungi revealed the highest zone of clearance in lignolytic ability and phosphate solubilizing ability in *Gibberella fujikuroi* and *Aspergillus terreus* respectively.

Adsorbent

Girish and George (2017) used areca nut husk, an agricultural waste, as an adsorbent for removing phenol from wastewater by chemically treating it with phosphoric acid in a ratio 1:4 and it showed a promising adsorbent capacity of 25.746 mg/g. Dried areca nut / husks and luffa (*Luffa cylindrica*) sponge fibres were used as alternative and inexpensive natural matrices for microbial cell immobilization for the efficient degradation of hazardous organic compounds like phenol. The bacterial consortium were isolated by enriching a sludge sample from a petroleum refinery in high phenol concentrations and were immobilized on the lignocellulosic matrices and reported that the immobilized micro-organisms could be stored at 4°C for up to 6 weeks and could be reused for several successive batch degradation experiments up to 15 times (Bera and Mohanty, 2020). Baidya and Kumar (2021) used sodium hydroxide treated areca nut husk as a bioadsorbent to remove brilliant green dye from an aqueous solution where the adsorption process was strongly pH dependant and an optimum removal of 97% brilliant green dye was obtained at pH 7.0. The sodium hydroxide activation process where methylene blue was used in betel nut husk-based activated carbon showed a high adsorption capacity (Bardhan *et al.*, 2020). In a study conducted by Ramesh *et al.* (2019), areca nut husk was used as an adsorbent, where the areca nut husk hydrochar was used to remove Pb²⁺ since it showed maximum removal efficiency of 95.08% at 25 mg L⁻¹ in the wastewaters.

According to a study done by Tabassum *et al.* (2020) betel nut husk used to produce activated hydrochar using sodium hydroxide (NaOH) was effectively used as an adsorbent for methylene blue adsorption. The adsorption efficiency improved over time, temperature, and pH. The thermodynamic data also revealed that the adsorption process was endothermic in character. The areca husk was pyrolyzed at 450°C for two hours to obtain biochar and their adsorption were investigated and found that the adsorption capacity increased with increase in initial iron concentration and contact time, but decreased with the adsorbent dosage (Subramani *et al.*, 2019). Akter *et al.* (2021) did a study on the pharmaceutical effluent for the reduction of COD from waste water using commercially activated carbon and areca nut husk treated activated carbon as adsorbents and found that areca nut husk treated activated carbon (ANHC) adsorbent can be used as a potentially low cost and environmental friendly adsorbent for the removal of organic

matter from pharmaceutical effluent.

Polymer composite

Studies have been carried out by alkali treatment using 5% sodium hydroxide on betel nut husk fibre and characterized for its chemical composition, tensile properties, morphology, and interfacial shear strength which showed higher Interfacial shear strength (IFSS) as compared to untreated BNH fibre due to the increase in fibre surface roughness and exposure of more reactive cellulose fibrils on BNH fibres surface due to alkali treatment (Lazim *et al.*, 2014). According to Yusriah *et al.* (2014), the physical, mechanical, thermal and morphological properties of betel nut husk fibre were investigated and it was found that the fibre length, diameter and density varied at each stage of the fibre maturity. Mechanical properties, the BNH fibre tensile properties were found to be comparable to coir and kenaf fibre.

Enzyme production

In a study by Sreena (2020), different kinds of agro-waste namely, areca nut husk, banana peduncle, jackfruit outer rind, pepper waste and tamarind husk were used as carbon source for producing endoglucanase enzyme. *Bacillus subtilis* treated areca nut husk gave the highest endoglucanase activity among different agro-waste. The endoglucanase production was enhanced by optimizing the medium via statistical method which led to an increase in endoglucanase activity. *Phanerochaete chrysosporium* and *Phanerochaete* sp. were used in solid state fermentation of manganese peroxidase (MnP) by using lignocellulosic biomass from areca nut husk as the substrate and the enzyme was partially purified by ammonium sulphate precipitation followed by ion exchange chromatography (Rajan *et al.*, 2010). In another study done by Nidhi *et al.* (2020), areca nut husk fibre was used as a substrate for the production of manganese peroxidase and was found to be effective by using *Fusarium* sp. in solid state fermentation. Narayanamurthy *et al.* (2008) in their study reported that when areca husk was used as a substrate for the production of citric acid under solid state fermentation (SSF) in the presence of 3% w/w methanol, it significantly increased the citric acid production by *Aspergillus niger*. Vardhan *et al.* (2020) studied the effect of acid and alkali pretreatment process on areca nut husk which showed that the areca husk fibre contained 29.17% hemicellulose which can be explored as a low-cost source of xylose. A study was conducted for the production of industrial fungal pectinase under submerged fermentation (SmF) by using efficient strains of fungal species from the areca nut husk waste. It was reported that out of 24 fungal strains, 20 strains showed the pectin degradation ability. Among them *Penicillium canescens* showed maximum pectinase activity and maximum exo-polygalacturonase activity was shown by *Rhizopus stolonifera* (Naveenkumar *et al.*, 2014).

Kumar *et al.* (2019) in their study found that using *Zymomonas mobilis* NCIM 2915 showed the maximum ethanol production after fermentation from areca nut husk by increasing the enzymatic hydrolysis and ethanol production through combinations of fungal pretreatment. Jackfruit seed and areca nut extracts were used to inhibit gut protease activity of *Spodoptera mauritia* as these proteinase inhibitors (PIs) inhibit the gut proteases of many insects. They reported that *Spodoptera mauritia* gut extract proteases cleaved casein and this proteolytic activity was inhibited by aqueous extracts of jackfruit seed and extract from areca nut up to 78% and 62 % respectively (Lakshmanan and Meethal, 2012).

Litter materials

Betel nut husks compared to rice hulls or dried leaves as litter material for broiler production on productive performance, carcass traits and internal organ characteristics was studied and it showed that the litter materials did not affect body weight gain, feed intake and feed conversion ratios during the experimental period (Azis *et al.*, 2020). In Hunan province of China, the husk of *A. catechu* L. is being processed into commercially chewable stimulant named “Binglang”. A quantitative analysis study of 5 alkaloids and 8 phenols in Binglang products was done for the first time and revealed the differences of contents of four areca alkaloids between the husk and seed products. Using traditionally unique processing methods of the raw husk for making binglang included roasting, steaming, boiling in water, and marinating in enzyme solution which lower the levels of areca alkaloids (Yuan *et al.*, 2018).

Compost

Nagaraja *et al.* (2014) did a study on areca nut waste such as the husk, leaf and the leaf sheath for value added compost and found that the C/N ratio of areca nut husk was found to be very high initially but when treated and inoculated with *Phanerochaete chrysosporium* and *Pleurotus sajarcaju* showed significant reduction in C:N. Higher C:N ratios slow material decomposition, because low nitrogen limits microbial activity. Gurumurthy *et al.* (2018) also reported in their study by using areca nut husk and efficient microbial consortia consisting of cellulolytic and lignolytic fungi and by further enrichment with nitrogen fixer and phosphate solubilizing bacteria could result into production of nutrient enriched compost up to 90 days in areca nut husk residue. Vijayanand *et al.* (2016) used areca nut shell waste that was charred at different temperatures as biochar. The biochar prepared at higher temperature contains a higher proportion of the stable organic matter than that of lower temperatures. When the temperature was increased to a certain extend the stable organic matter yield was decreased and because of this biochar is more applicable for soil carbon sequestration.

Extraction and stability of pigment from areca nut

Han *et al.* (2010) reported in their study of the areca nut seeds used as raw material to extract a natural red pigment by organic solvent extraction, and the stability of the pigment obtained was evaluated. The results showed that the optimum extraction process of areca nut pigment was achieved by using 70% ethanol to extract areca nut seeds and the pigment had good stability under light illumination or acidic pH value, strong reduction resistance, but poor antioxidant capacity. Jose *et al.* (2018) in their study of antioxidant activities and free radical scavenging properties in mango leaves, husks of areca and coconut reported that all plant materials exhibited efficient free radical scavenging activity and the activity of areca husk was found to be relatively less. Analysis of phenolic compounds and immunomodulatory activity of areca nut extract was done against *Staphylococcus aureus* infection in Sprague-Dawley rats and found that areca nut extract could increase the number of WBCs and improve the activity and capacity of macrophages in rats infected with *S. aureus*. The antioxidant activity of areca nut might be attributed to the presence of catechin and quercetin (Sari *et al.*, 2020).

Quantitative determination of total phenolics and tannin in areca nut and its products reveal that the phenolic contents of dry unripe areca fruits were higher in betel nut than in unripe areca fruits and areca husk, and it was least in betel products (Zhang *et al.*, 2008). Tannin is obtained as a by-product from the process of preparing immature betel nuts for masticator purposes. It is being used for dyeing clothes, tanning leather, adhesive in ply board manufacture and as safe food colouring agent (TSS, 2018).

Antimicrobial properties

A study was done by Cyriac *et al.* (2012) on areca nut husk extracts on their antimicrobial properties against common oral pathogens like *Streptococcus mutans*, *Streptococcus salivarius*, *Streptococcus mitis*, *Lactobacillus acidophilus*, *Candida albicans*, *Prevotella intermedia* by agar well diffusion method and found that areca husk contains chemical components that has antifungal effect and would improve the oral health primarily through mechanical cleansing rather than antimicrobial activity. Anupama *et al.* (2021) studied the antimicrobial properties of areca nut against common bacterial pathogens viz., *Staphylococcus aureus* and *E. coli* and found that they were susceptible to the areca nut extract and 85-90% growth inhibition was reported. A study done on anthelmintic and antibacterial effects of extracts from Chinese honeysuckle seeds and areca nuts against ascarides, flukes, and *E. coli* strains showed that areca nut extracts were more effective against flukes and bacteria (Hai *et al.*, 2019). The activated carbon prepared from some biomasses were tested for its antibacterial capacity namely rubber wood, ramie fibre and areca nut husk against waterborne pathogen *Escherichia coli* and reported that areca husk

exhibited the highest killing effect of 43% when compared to other samples with different dosage concentrations (Das *et al.*, 2019).

Mushroom cultivation

A study was done on substrates for the cultivation of *Pleurotus ostreatus* on various substrates such as topsoil, areca nut husk, areca palm leaves, bamboo shoots, and its mixture with topsoil were used for cultivation and observed the highest mycelia growth in topsoil followed by areca nut husk (Sharmila *et al.*, 2015).

Conclusion

Consumption and use of areca nut are quite significant in the Northeast especially in Meghalaya. Certain varieties of the raw nut are put to fermentation for change of flavour and taste of the nut. This traditionally practiced process has not been studied and the diversity and dynamics of microbes prevalent during the process is still unreported. Meghalaya being the 5th highest producer of areca nut in India (Nandula, 2014) has a lot of potential make use of the agrowaste produced by betel nut. Thus, betel nut husk can be explored for producing different kinds of product which can be very useful as this agrowaste is not being utilized properly after processing of the areca nuts.

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Contamination by fake news distributions during the Covid pandemic

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Abstract

In the wake of the worldwide internet, people across the globe are now facing additional malice that has the power to wreak havoc on society. This malice is the spread of fake news and hoaxes that has almost taken pace post imposition of the nationwide lockdown by the Indian Government. In addition to social media, numerous websites, and apps, mainstream media such as newspapers, television, and radio also contribute to the proliferation of fake news. Despite the extensive coverage of the pandemic, there is some information that represents the outbreak, its severity, spread, and other false claims. In the following paper, we will discuss some crucial aspects of the fake news agenda that will determine whether people are aware of fake news or not and whether they have the skills to deal with the situation, especially in the context of the Covid 19 pandemic. In this paper, we intend to educate readers about fake news and hoaxes, as well as how to protect yourself from spreading them.

Keywords: COVID 19, Fake News, Social Media, News Agenda, Main Stream Media

Introduction

Globally, governments have quickly turned to desperate measures in response to the recent Covid-19 pandemic, while the Indian government tried to mitigate the virus through an outsized set of activities. The emergence of worldwide internment poses an additional threat to humanity, potentially threatening to wreak further havoc on society. It is this malice that has begun to spread since the Indian government imposed the nationwide lockdown. In addition to social media, several websites and apps are also part of this fake news ecosystem, as are mainstream media outlets, such as newspapers and television stations. In this part of the article, it is pertinent to note that false information about the pandemic, its severity, its spread, or any other aspect involved is known as “fake news”. The “Ethical Journalism Network” has compiled the most comprehensive definition of “fake news” by far; there is no universal agreement on the concept. The report defines

fake news as “Information that has been consciously fabricated and disseminated with the intent of deceiving others into consuming falsehoods or doubting the veracity of facts”.

Hence, ‘fake news’ must satisfy the following criteria to be regarded as such:

- Be made up of false information or decorations
- Be deliberately designed to lead the recipient into believing in things that are not true, or into doubting verifiable facts, and finally
- Create an appearance that is so much like traditional news that it cannot be discerned from it, thus manipulating the recipient’s sense of trust to the fullest.

Recent outbreaks of the novel Corona virus that have killed hundreds of thousands of people globally indicate that the fake news factories are on steroids. There is nothing unusual or new about fake news spreading and unfolding specifically through social media like Face book and WhatsApp in the country with approximately 200 million WhatsApp users and is also its largest market. People belonging to specific communities, such as Muslims and transgender people, were mentioned in some fake news content. News like this has exacerbated hatred and violence against minority communities and sometimes led to the denial of medical aid. Some videos also became viral on Facebook and Twitter, which showed Muslims spitting on food, supposedly on purpose.

Objectives

- To determine whether people are aware of fake news.
- Check to see if they know how to deal with the situation.
- Educate them about fake news and hoaxes, how to protect themselves against them, and how to stop spreading them.

Methodology

The researchers used a fixed methodology to conduct this research, “Fighting Fake News amidst Covid Pandemic and Fact-checking Guidelines.”.

1. Qualitative method

- Secondary data on fake news
- Focused Group Discussion
- Interview

2. Quantitative method

- Field Survey

Conceptualizing “Fake News”

The term “fake news”, typically made public as “false, sensational data disseminated below the duvet of news reporting”, gained such a lot of attention that it was named the Collins Word of the Year 2017 because of its increase in usage to 365% within the Collins Corpus. Fake news is but nothing but a typical false story that appears to be spreading on the web or other media as news, generally created to influence views and thoughts and in some cases as a joke. It is a form of information that consists of deliberate information or hoaxes that unfold through print, broadcast, or online media. Fake news is written Associate and printed with the intent to misguide to cause interruption or harm to an entity, person, or organization, manufacture disturbance, and unrest through exploitation, and by using attractive dishonest and decorated headlines to increase audience, online sharing, and net-click revenue. The term “fake news” was first accustomed to describe satiric shows and publications (i.e.: Daily Show, The Onion). For creators of such content, the idea meant made-up news, with the pursuit of amusing others, and not for informing or spreading information. Some students claim that humor ought to be disregarded as the “new definition of fake news” due to its “unlikely to be misconstrued as fact, and it has no intention to inform audiences (Alcott and Gentzkow, 2017). While it is legally protected speech, it might appear to be telling the full truth. For example, in 2017, a satire website run by Christopher Blair agreed to give an apology for creating their story “too real,” when several viewers were unable to notice its sarcastic nature (Funke, 2017).

While the thought itself is not new – false information and mistruths have been circulating for as long as stories have been told – smartphones, the internet, and social media have encouraged it a new lease of life and a new high-speed distribution mechanism. In our hyper-connected world, false information can spark “Digital Wildfires,” according to the World Economic Council’s Global Risks Report from 2013. Things are more complicated than it seems since not all of the information shared online is total fiction. Fact-checking website Snopes.com founder David Mikkelson presents a distinction between “fake news” and “bad news” – a thing he defines as “shoddy, unsearched, error-filled, and deliberately dishonorable coverage.”

Fake news is often as slippery to outline as it is to pin down. Stories can also be factually inaccurate and deliberately published to underscore a particular viewpoint or drive countless guests to a website, or they could be partially true but exaggerated or not properly fact-checked before publication.

Sub-categories of spreading of fake news

There are several subcategories of fake news: -

- **Conformity and Peer influence-** This is the desire to adhere to the norms of a particular social group. Social media users may blur the distinctions between authentic and false information due to their desire to portray themselves better on social media platforms. The message or content on social media platforms, such as Twitter, gains amplification when connected to specific users or influencers. The exchange of information depends on the reputation and credibility of those associated with the knowledge. All sorts of data are propagated and made more impactful by social media users and their influence among peers.
- **Social Comparison-** Comparing members of similar social environments who hold similar views and beliefs. A significant problem associated with fake news is that the newsfeed on social media platforms, like Facebook, is often populated with their likes and opinions, providing an opportunity for users with the same beliefs to spread false information amongst themselves.
- **Satire and Humorous Fakes-** Some of the content on social media aims to amuse users and deceive them into thinking that the content is genuine. The purpose of satire or sarcasm is to mock or criticize the ideas or opinions of people in an amusing manner. In most cases, sarcasm seeks to mislead or instruct a particular group of people. Some social media users may realize that the data is accurate and can therefore share it with others.
- **Cognitive Factors-** As social media users receive an increasing amount of content, it may be challenging to determine which content is closer to the primary and original source of knowledge. Most social media users rarely investigate the information they read or share. The problem of people not having the power to differentiate between real and pretended news will thus cause the fast sharing and spreading of almost unbridled data across social media platforms.
- **Knowledge and Edification-** When surfing social media, social media users must distinguish between what is real and fake. The authenticity of a particular article relies on the extent of exchange of the articles. Social media users build purportedly reasonable justifications to see the legitimacy of the data provided.
- **Political factors-** The spreading of false political data has multiplied the emergence of streamlined media environments. By making false political statements, voters are convinced or persuaded to alter their opinions. Several techniques are accustomed to the modification of public opinion. These techniques include repeatedly retweeting or sharing messages, usually with the aid of bots or cyberpunks. It conjointly includes dishonorable hyperlinks that lure the social media user to a lot of false data.
- **Political Click baits-** These sites usually offer information and sensationalism as a

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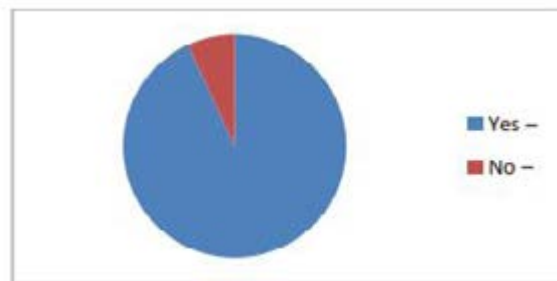
way to attract readers. For political purposes, some web pages pretend to appear like genuine web pages. News sources with URLs almost identical to the actual website are familiar with the unfolding and spread of political fake news items that may influence public opinion.

- **Malicious Bots/ Cyborgs-** Malicious users, with the assistance of bots, target absent-minded people who won't check the article's facts or the source of information before sharing it on social media. These AI high-powered bots are designed to mimic human behavior and characteristics and are misused to create corruption by indulging unwanted and dishonest advertisements in online conversations.
- **Hate Propaganda-** Some contend that sharing false information stimulates vengeful behavior among social media users. Some hoax-sharing websites or pages exist specifically to hurt a particular individual's name. Fake news creators specifically target users with false knowledge. This misleading info aims to deceive and manipulate social media users.

Data collected from field survey

➤ Are you a regular user of Social Media?

Out of 102 responses, 93% of our sample size does use social media regularly.

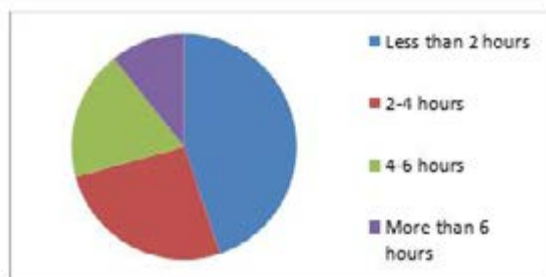


➤ How much time do you spend on Social media sites?

The responses received from 102 responses is listed below.

Less than 2 hours	45%
2-4 hours	26%
4-6 hours	18.60%
More than 6 hours	10.80%

As seen in chart below, 45% of our sample does use social media for less than 2 hours, 25.5% of them uses for 2-4 hours, 18.6% use or 4-6 hours and 10.8% of them use social media for more than 6 hours.



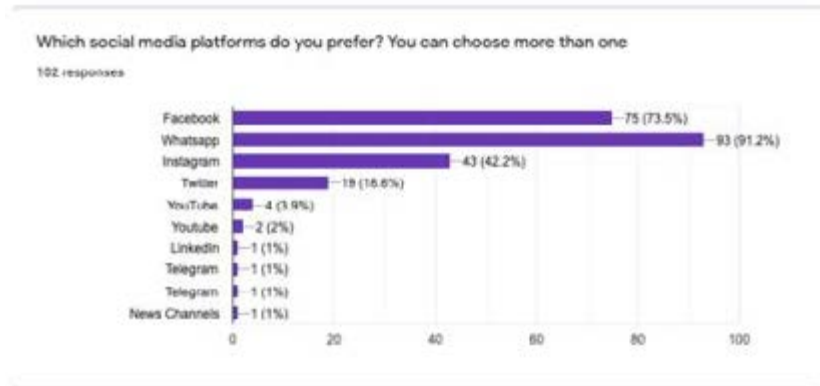
➤ **Which Social media platforms do you prefer? You can choose more than one?**

The responses received form 102 responses is listed below

Range	0-20	20-40	40-60	60-80	80-100
Facebook					75(73.5%)
Whatspp					93(91.2%)
Instagram				43(42.2%)	
Twitter	19 (18.6%)				
Youtube	4 (3.9%)				
Linkedin	2 (2%)				
Telegram	1 (1%)				
News Channel	1 (1%)				

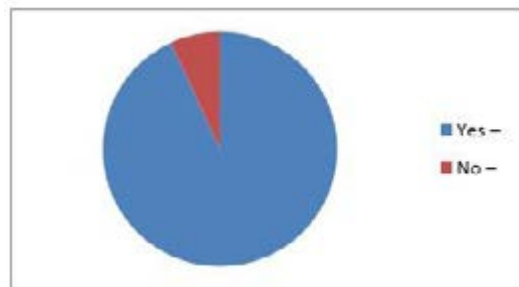
Contamination by fake news distributions during the Covid pandemic

As we can see in chart below, 91% of our sample does prefer Whatsapp and 73.5% of them prefer Facebook just after whatsapp and others respectively.



➤ Do you think social media is a reliable source to get Covid related news?

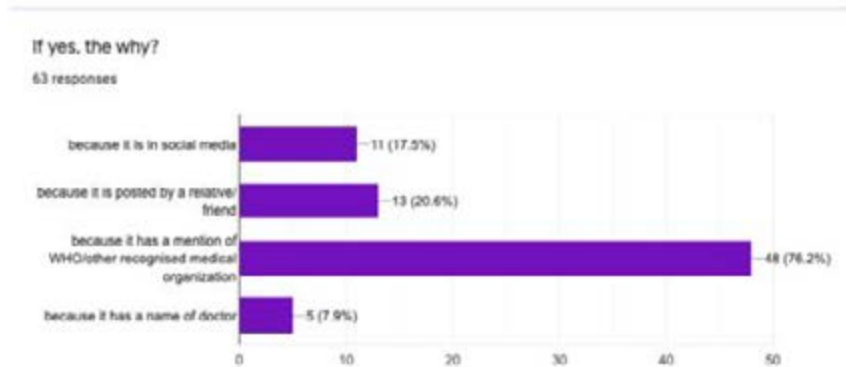
The responses received form 102 responses , the percentage is Yes – 60.8% and No – 39.2%. When we ask them if the social media is a reliable source to get Covid related information, 60.8% of them answered as ‘YES’ and others doesn’t think so.



➤ The response Yes, led the question of Why, which provided the following responses.

Answers	0 to 10	10 to 20	20 to 30	30 to 40	40 to 50
Because it is in Social Media		11 (17.5%)			
Because it is posted by a relative / friend		13 (20.6%)			
Because it has a mention of WHO/ other recognized medical organization					48 (76.2%)
Because it has a name of doctor	5 (7.9%)				

76.2% of our sample answered that ‘because some post has a mention of WHO/other recognized medical organization’ that is why they believe the social media news.

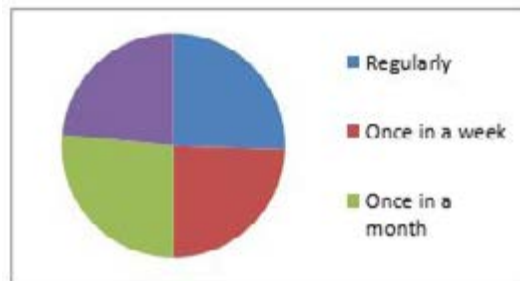


➤ How often do you share posts on Social Media?

The responses received from 102 responses is listed below

Regularly	25.5%
Once in a week	24.5%
Once in a month	26.5%
I don't share posts	23.5%

26.5% of our sample does share post once in month, 23.5% of them don't share anything at all, 25.5% of them shares posts regularly, and 24.5% of the sample shares posts once in a week.



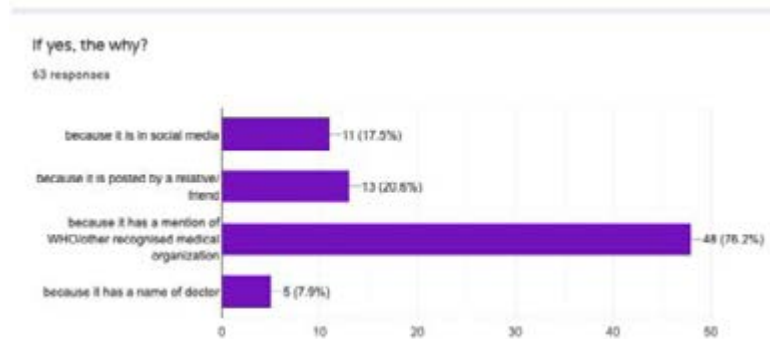
Contamination by fake news distributions during the Covid pandemic

- **What should you do if your common sense tells you that a message or post is fake or false information?**

The responses received form 102 responses is listed below

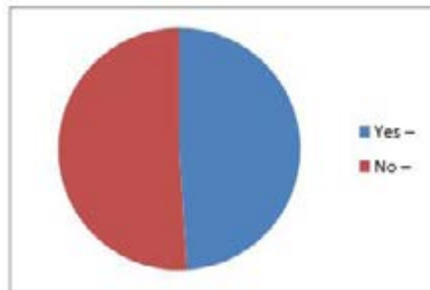
ANSWERS	0 to 20	20 to 40	40 to 60
Delete the post		31 (30.4%)	
Recheck it		22 (21.6%)	
Report it		34 (33.3%)	
Ignore it			51 (50%)

51% of our sample does ignore a post when they realize that a news can be false or fake. Only 33.3% of them report it.



- **Do you know about ‘Fact checking?’**

The responses received form 102 responses had Yes – 49% and No – 51%. Interestingly 51% of our sample does know about ‘fact checking’ and the rest of does not.



➤ Do you know about the Process?

The responses received from 102 responses had Yes – 71.6% and No – 28.4%. But when they are asked about the process 71.6% doesn't know how to and the rest does know.



Expert's Interview

Miss. Laura Unger

(Investigative and Enterprise, editor at Courier Journal, Investigative reporter at USA Today)

In the first instance, the question was addressed to Miss. Laura Unger was that her opinions about the recent fake news publishing activities by reputed news houses on their digital platform. She replied that every time she comes across the fact of newspaper organizations sharing decorated and unreal stories, she gets dismayed. The activity is unacceptable for her. She feels that people tend to believe reputed news organizations, and it's unconscionable

It is not ethical to intentionally mislead people. Media is such a body upon which the common people have blind trust. Somewhere people have a faith that anything and everything shared on social media is possibly true. Taking advantage of this belief and sharing false information on digital platforms results in hurting the sentiments of common people and manipulating them as well.

Secondly, she was asked about her suggestion to viewers and readers on how to deal with fake news on social media published by reputed sources. She answered that Readers should demand that media houses stop providing fake news. Likewise, they must realize they have to vary their news intake to gauge what is real and what is not. They should try to dive more into the news content so that they could get an in-depth verification and scrutiny. They should go for fact-checking every time they suspect any news to be real. Their urge to get clear and true knowledge can be the best way to fight the spread of fake news in digital media.

Finally, we wanted to know from her what kind of background checking does she use

whenever she finds out a piece of news to be suspicious enough. She explained that Editors need to require their reporters to do old-fashioned shoe-leather reporting as well as use available databases to do fact-checking. Reporters cannot, for example, depend on just one source for their stories. **They need to talk to several sources and check records such as police reports, government databases, court records, etc.** Moreover, all reporters should check and re-check every data they get from various sources. She follows this approach, as a reporter when it comes to fact-checking, so they don't publish everything that comes to their desks.

Mr. Sujoy Dhar

(Group editor at India, Blooms News service, India Correspondent for USA Today)

He commences the interview by saying that his whole team must carry out a background check for each content they receive from non-official sources. Every journalist should view anything they get their hands on with suspicion since that will automatically lead to background checks. For that, the main and the main thing is the 'Internet'. Their task is to find out the possible origin of the content by looking after some keywords, official social media handles, twitters, Instagram accounts, etc. For example, he mentioned the incident in Japan in which news went that Japan was blowing crackers as they couldn't host the Olympic Games this year. Mr. Dhar says that when such a story circulates, people must ensure they apply common sense as in the case mentioned here. As soon as people hear this news, it should strike in their mind that how is it possible for a country like "Reporters should not depend on just one source for getting information or checking the authenticity of the news. They should also go for records such as police reports, Japan that has been badly stricken by the pandemic can celebrate with crackers. So, the job of the Journalists and common people is to apply their common sense whenever they find any news.

When asked about the recent problem of the spread of fake news in various reputed media, he stated that people must first up all know the difference between fake news and opinionated news. Editorialized and opinionated news is not fake news. It is somebody's opinion and others may or may not like it. But if someone from the media house is like slamming a politician or questioning someone, he/she can do that because in media they have every right to do that but of course with some authentic information. Likewise, it will be helpful if they editorialize that what is good or bad to one person may not be the same to another. If a newspaper publishes anything in good faith while adhering to its editorial policy, it cannot be identified as fake news. Most of the time, newspaper organizations and television channels are responsible for what they publish, and then it isn't considered falsified. It might later be proved wrong but it can never be pointed as intentionally created fake news. He suggests that whatever people see on social media,

the easiest way to verify it is to go on the internet and track that particular content or video. Viewers and readers must always be interested in knowing when, where, and how the social media content circulates. On social media, things are posted by people and, of course, they are not accredited or verified, nor are people on social media expected to take responsibility. The first thing one should do when they see content on social media is to be suspicious, then conduct some background checks, and finally post if the source is legitimate.

Last but not least, when asked for his recommendations to viewers on dealing with fake news, he recommends that they be very cautious when believing and circulating any news. A lot of damage occurs when people believe fake news and spread it. There have been several instances in India of lynching based on fake news and messages shared via WhatsApp. **Lastly, in a satiric tone, he adds that people must take cases of sharing news and contents as arranged marriage through matrimonial sites where people check and recheck every detail before fixing the marriage.** In addition to checking and rechecking, people should follow the same guidelines.

Focused Group Discussion

Concerning the Focused Group Discussion included in the survey, it has come to our attention that most of the people participating in the survey were regular social media users (Facebook, Whatsapp, and Instagram). There was also evidence that the interviewees also faced some fake news during the Covid pandemic crisis like sanitization removes Covid, Side effects of Vaccinations, Vaccination can destroy human organs, Magnetic energies related to vaccination, and so on. Whenever there is a health issue, experts recommend using government websites or WHO instead of social media, since social media presents different news information, and the public cannot access reports published by official organizations. The Indian medical industry has been accused of manipulation and changing opinions through social media as it provided vitamin tablets produced in its factories to victims of the Covid outbreak, with the promise that it would cure them of the illness. WHO has confirmed that the only way to defeat covid is by developing an extremely effective immune system. Further, interviewees indicated that fake news on social media is decreasing significantly since 2020. Now, People are not aware of fact-checking, but as a substitute, they are depended on their instincts to cross-check whether the news is real or fake.

Key Findings

- All of them use social media, mostly use Facebook, WhatsApp.
- Everyone gets fake news during pandemic about COVID-19

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- 6 of them get fake news through Facebook and one of them get through WhatsApp forward.
- Few of them have the basic idea of Fact Check.
- Few of them ignore fake news and few of them report the fake news after fact check.
- People are a bit confused about what to trust and what not
- Certification of authorized organization is convincing.
- Members have no such idea about “fact-checking”

Analysis and Findings of the study

- The main and major aim of the awareness campaign was to raise awareness about fake news, how to identify fakes and provide a brief overview of the process of fact-checking, including such sites.
- The awareness campaign was conducted through the Google meet platform and there were 45 members present in the campaign.
- From the focused group discussion, it was clear that most people have encountered fake news more than once in their lifetime but their concept of dealing with them was not clear. So, the main aim of the campaign was to make them understand the ways of handling fake news.
- Most of them had no clear idea about “fact-checking”. So, the target was to explain the process of fact-checking and the various fact-checking sites easily accessible. The URLs of several sites have also been provided.
- Following the discussion campaign, participants received a survey asking whether they had a clear understanding of how fake news is handled and fact-checked.

Conclusion

By using social media platforms, you can contain the spread of fake news. Many focus groups were examining the lack of information and knowledge about fake news. Towards the end of the process, we explored questions of clarity and loopholes. In response to their feedback, they said they were on the right path to learning about fake news and had sufficient information about it. Based on the charts and figures, it seems people who once had a vague idea about false content, misinformation, and hoaxes are now savvy enough to decide what content to trust and share. So overall, the campaign can be said as a successful attempt.

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Currency notes in circulation can be potential sources of transmissible diseases

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Abstract:

In the modern era, currency is the primary medium for exchange of goods and services. The material of Indian currency notes makes it a hub for microorganism to thrive. Taxi drivers exchange currency with customers for different regions and backgrounds and meat sellers are known to use bare hands for butchering of the meat and exchanging currency with customers without washing or sanitizing. This paper highlights the presence of multitude of bacteria which have the potential to cause diseases as well as being antibiotic resistant. 20 different strains were isolated, 10 each from currency notes obtained from a local taxi driver and meat seller. Biochemical tests for identification of these bacteria were performed which suggests presence of bacteria such as *Vibrio gazogenes*, *Chrysomonas luteola*, *Vibrio cincinnatienses*, *Vibrio metschnikovii*, *Staphylococcus intermedius*, *Vibrio gazogenes*, *Flavimonas oryzihabitans*, *Vibrio gazogenes*, *Micrococcus mucilaginous*, *Salomonella* sp., *Micrococcus luteus*, *Staphylococcus simulans*, *E. coli*, *Photobacterium angustum*, *Streptococcus* sp., *Pseudomonas mallei*, *Salmonella paratyphi* and *Pseudomonas malle*. The isolated bacteria were resistant to Penicillin, Ceftizoxime and Gentamycin with some Gram-positive bacterium being resistant to vancomycin, ceftizoxime and penicillin with gentamycin showing little to no effect.

Keywords: Bacteria, Antibiotics, Pathogen, Currency notes, circulation

1.1 Introduction:

Currency is the primary medium of exchange in the modern world, having long ago replaced bartering as a means of trading goods and services (Felgo and Nkansah, 2010). The Indian rupee's rich history traces back to circa 6th century BCE of ancient India, and was one of the earliest issuers of coins in the world (Kapoor, 2002). But there is a huge possibility of microbial contamination and spread of diseases through currency exchange (Prasai *et al.*, 2009). Internationally, paper currency is made of a rugged mix of 75%

Currency notes in circulation can be potential sources of transmissible diseases

cotton and 25% linen, and offers surface area for bacteria and microorganisms to reside on both sides (El-Dars *et al.*, 2005). According to the Reserve Bank of India (RBI), an Indian note uses 100 percent cotton. Cotton-based currency notes contained three times higher bacterial counts than polymer-based ones concluding that the spaces between the cotton fibers provide favourable anchor for the bacteria (Vriesekoop *et al.*, 2010).

There are many modes of microbial transmission like air, water, physical contact, food etc. (Pradeep *et al.*, 2012). Pathogen may spread through touching of currency notes. Due to lack of hand washing/sanitizing, there is possibility of spread and ingestion of pathogen as it is local practice to eat with bare hands, along with the practice of licking the tip of the finger while counting money and making skin contact.

Being a popular tourism state, and home to many prestigious educational institutions, where students from all over India study and reside, the local taxi drivers of Meghalaya exchange currency with local customers as well as tourists/students from all over India and abroad which may lead to inhabitation of a wide range of flora.

Local meat sellers have been observed to use bare hands to touch, cut meat and exchange currency with customers without hand washing or sanitizing. A variety of microbes can contaminate meat, depending on pH, oxygen, water availability, and storage temperatures different species may become dominant (Ercolini *et al.*, 2006). Foodborne pathogens such as *Salmonella* sp. and *Escherichia coli* contaminate the carcass and spread to the raw meat (Lecos *et al.*, 1987). The currency notes may become contaminated via touch and later exchanged with unsuspecting customers.

Emergence of antibiotic resistant bacteria has led to a health crisis in recent years, especially in developing countries where relatively easy availability and higher consumption of medicines have led to disproportionately higher incidence of antibiotics resistance compared to developed countries (Geneva, 1996). According to the World Health Organization, the epidemiological aspects of antimicrobial resistance in most of South East Asian countries is not well known. Antimicrobial resistance will result in difficulty in controlling the diseases in the community and ineffective delivery of the health care services. Meta analyses of the drug susceptibility results of various laboratories in India reveal an increasing trend of development of resistance to commonly used antimicrobials in pathogens like *Salmonellasp.*, *Shigellasp.*, *Vibrio cholerae*, *Staphylococcus aureus*, *Neisseria gonorrhoeae*, *N. meningitidis*, *Klebsiellasp.*, *Mycobacterium tuberculosis*, HIV, plasmodium and others (Felgo and Nkansah, 2010).

The study considered currency notes of ten rupees randomly from a taxi driver and twenty rupees notes from a meat seller. In this study, the microflora of bacteria existing in

these notes were examined for presence of antibiotic resistant strains and established a comparison with drinking water to raise awareness keeping in mind the pandemic situation which is connected with the spread of microorganisms from everyday material.

1.2 Study area

East Khasi Hills is an administrative district in the state of Meghalaya in India. The district headquarter is located at Shillong. The district occupies an area of 2752 km² and has a population of 825,922 (as of 2011). East Khasi Hills District forms a central part of Meghalaya and covers a total geographical area of 2,748 km². It lies approximately between 25°07" & 25°41" N Latitude And 91°21" & 92°09" E Longitude. The present study considered the isolation and characterization of bacteria from currency notes collected from a local taxi driver and meat seller of the East Khasi Hills.

1.3 Methodology

1.3.1 Sampling

Samples were collected from a local taxi driver designated as Sample 1 and meat seller designated as Sample 2 using sterile disposable gloves and autoclaved sampling bottles. Currency notes of denominations of Rs 10 and Rs 20 were randomly collected from a local taxi driver and meat seller respectively. To ensure proper touch by meat seller, chicken meat was bought and currency was exchanged.

Samples were transferred to two sterile flasks and standard method was followed to get the microbes on the solution as the source of microbial samples.

1.3.2 Isolation of bacteria

Serial dilution of the samples was done using sterile test tubes which were labelled 10⁻¹ to 10⁻⁷ dilutions. 9 ml of 0.85% NaCl were then measured into the seven test tubes. 1 ml of sample solution was introduced into the first test tube labelled 10⁻¹ and mixed thoroughly, and 1 ml was taken from the first test tube and transferred to the second test tube labelled 10⁻². This was continued until the 10⁻⁷ dilution was obtained. 0.1ml of samples from 10⁻⁵, 10⁻⁶ and 10⁻⁷ dilutions were inoculated on each nutrient agar plates by the spread plate technique. The plates were then incubated at 37°C for 18-24 h. The growing colonies on the plates were recorded as colony forming unit (CFU) (Brown,2009) and the number of bacteria in the samples was expressed as CFU/ml which was calculated as CFU X Dilution factor/ Volume of sample plated.

1.3.3 Pure culture generation

Based on the colony morphology, 20 of the most prominent bacterial colonies, 10 from each sample were isolated using sterile loop and streaked into nutrient agar plates. Resultant single distinct colonies were sub-cultured in slants and maintained at 4°C for further studies.

1.3.4 Differential staining using Gram's stain

Gram's staining technique was used to find out the Gram staining nature of the bacterial isolates. A loopful of fresh overnight grown bacterial culture was smeared on a clean slide and then allowed to air dry. The smear was then heat fixed by passing the glass slide over a flame. Few drops of primary stain i.e., crystal violet was added and left for 60 seconds and then washed with distilled water. Gram's iodine, a mordant was added for 1 minute and the slide was washed away with Gram's decolourizer (ethyl alcohol 95%). Finally, safranin, counter stain was added for 1 minute which was then washed with distilled water. The glass slide was left to air dry and examined under the microscope.

1.3.5 Biochemical characterization

1.3.5.1 Catalase test: This is a test to ascertain the ability of bacteria to produce catalase that reduces hydrogen peroxide to water and oxygen. Growth of samples were scraped with wired loop. It was then suspended in a drop of 3% H_2O_2 on a slide, then examined for bubble formation. If effervescence occurs, it is confirmatory positive test for catalase production, but if it does not occur it is negative test for catalase production.

1.3.5.2 Oxidase test:

This test depends on presence of certain oxidases in bacteria that will catalyse the transport of electrons between electron donors in the bacteria and a redox dye- tetraethyl p-phenylene-diamine which is reduced to a deep purple if positive. A strip of filter paper was moistened with freshly prepared 1% solution of the reagent. Immediately, a speck of culture was rubbed on it with a loop. Positive test is indicated with an intense deep purple blue within 10-60 seconds. No colour change after 60 seconds indicates a negative result.

1.3.5.3 Citrate Utilization test:

Citrate is acted upon by enzyme citrase which produces oxaloacetic acid and acetate. These are enzymatically converted to pyruvate and CO_2 . During reaction, the medium becomes alkaline as the CO_2 combines with Na and H_2O to form sodium carbonate which is alkaline. Simmon's citrate medium slants were prepared. Samples were inoculated into

agar slants and incubated for 24-48 hrs at 37°. Positive result is indicated by blue colour slope and no colour change indicates a negative result.

1.3.5.4 Triple Sugar Iron (TSI) test:

This test depends on ability of bacteria to ferment lactose, sucrose and glucose and the production of hydrogen sulphide. TSI agar medium was prepared, dispensed in test tubes, sterilized and allowed to set as slopes. Slants were inoculated with samples and incubated for 18-24 hours at 37°C. Yellow butt, red slant indicates positive glucose fermentation. Yellow butt, yellow slant indicates positive lactose and/or sucrose fermenting. Red butt, red slant indicates neither glucose, lactose, sucrose fermenting. Black precipitate at bottom of slant indicates H₂S production.

1.3.5.5 Methyl red test:

This test detects ability of microbes to oxidise glucose with production and stabilization of high concentration of acid end products. MR-VP broth was prepared, sterilized and inoculated with samples and incubated for 48 hours at 37°C. Following incubation, 5-6 drops of methyl red solution was added. Bright red colour change indicates positive result, red- orange colour indicates a weak positive result and yellow- orange indicates a negative result.

1.3.5.6 Voges-Proskauer test:

The Voges-Proskauer (VP) test is used to determine if an organism produces acetyl methyl carbinol from glucose fermentation. If present, acetyl methyl carbinol is converted to diacetyl in the presence of α - naphthol, strong alkali (40% KOH), and atmospheric oxygen. MR-VP broth was prepared and inoculated with samples and incubated for 48 hours at 37 °C. Following inoculation, Barritt's reagent A and Barritt's reagent B was added to the broth in a 3:1 ratio. Tubes were shaken at intervals to ensure maximum aeration. A positive result is indicated by the development of a pink colour in 2.5 minutes, becoming crimson in 30 seconds and no colour change indicates a negative result

1.3.6 Antibiotic susceptibility by Kirby's disk diffusion assay

This method relies on the inhibition of bacterial growth measured under standard conditions. For this test, Mueller-Hinton agar was uniformly and aseptically inoculated with the test bacterial samples. Antibiotic discs were placed on the surface of the agar aseptically. The plates were then incubated for 24 hours at 37°C.

The organism grows on the agar plate while the antibiotic inhibits the growth. If the organism is susceptible to a specific antibiotic, there will be no growth around the disc

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containing the antibiotic. Thus, a “zone of inhibition” can be observed and measured to determine the susceptibility to an antibiotic for that particular organism. The measurement is compared to the criteria set by the Clinical and Laboratory Standards Institute (CLSI). Based on the criteria, the organism can be classified as being Resistant (R), Intermediate (I) or Susceptible (S)

1.4 Observation and results

1.4.1 CFU calculation:

Serial dilutions of the samples at 10^{-1} , 10^{-2} , 10^{-3} , 10^{-4} , 10^{-5} , 10^{-6} and 10^{-7} dilutions were prepared and dilutions of 10^{-5} , 10^{-6} and 10^{-7} were plated. Countable colonies were observed only in the 10^{-7} plate and considered for bacterial enumeration.

It is to be noted that samples of soil and fresh water which are hubs for bacterial flora usually provide countable colonies in 10^{-3} or 10^{-4} dilutions. However too numerous to count (TNTC) w convey the higher bacteria carrying capacity of the samples. The dilution plates and the streak plates are presented in the Fig 1a and Fig 1b respectively. The summary of the CFU obtained is shown in Table 1.

A comparison was established with drinking water as control and 0.1 ml of the sample was plated along with 10^{-1} and 10^{-2} dilutions where no growth was observed.

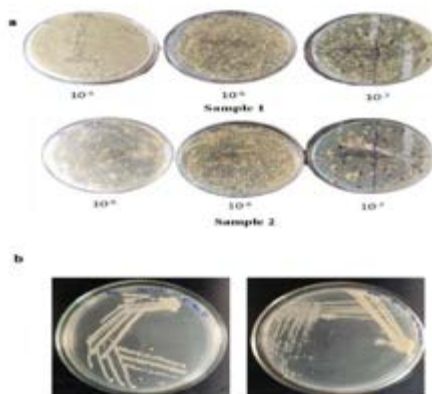


Fig 1: (a) CFU of sample 1 and sample 2 (b) Streak plates

Table 1. Summary of CFU obtained for Sample 1 and Sample 2

Sample 1		Sample 2	
Dilution	No. of colonies	Dilution	No. of colonies
10^{-5}	TNTC	10^{-5}	TNTC
10^{-6}	TNTC	10^{-6}	TNTC
10^{-7}	290	10^{-7}	230
Sample		CFU/ml	
Sample 1		2.9×10^{10}	
Sample 2		2.3×10^{10}	

(TNTC- Too numerous to count)

1.4.2 Gram staining

In this study, out of the total 20 isolates obtained from Sample 1, 2 isolates were found to be Gram positive and 8 isolates were found to be Gram negative. Similarly, from Sample 2, 3 isolates were found to be Gram positive and 7 isolates were found to be Gram negative. The colony morphology and the Gram nature of the isolates are shown in Fig 2 and Table 2.

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Table 2. Colony morphology and Gram nature of the isolates obtained from Sample 1 (M1-M10) and sample 2 (T1-T10)

Isolates	Gram positive	Gram negative	Morphology
M1	-	+	Cocci
M2	-	+	Bacilli
M3	-	+	Bacilli
M4	-	+	Cocci
M5	+	-	Cocci
M6	-	+	Cocci
M7	-	+	Cocci
M8	-	+	Bacilli
M9	+	-	Chain
M10	-	+	Bacilli
T1	+	-	Cocci
T2	+	-	Cocci
T3	-	+	Bacilli
T4	-	+	Cocci
T5	+		Cocci
T6	-	+	Bacilli
T7	-	+	Bacilli
T8	-	+	Bacilli
T9	-	+	Bacilli
T10	-	+	Bacilli

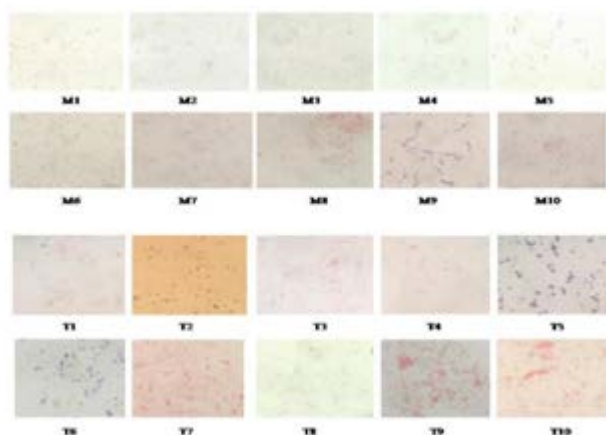


Fig. 2. Colony morphology and Gram staining of the isolates

1.4.3 TSI test:

The samples were observed after incubation for 18-20 hours at 37 °C. Isolates M1, M2, M3, M4, M5, M6, M8 of sample 1 and T2, T6, T7, T8, T9 of sample 2 were observed to have red butt-red slant which indicated that these samples cannot ferment glucose, lactose and sucrose and hence as TSI negative. The isolates M7, M9, M10 of sample 1 and T3, T4 isolates of sample 2 showed yellow butt-red slant and are glucose fermenting. Yellow butt-yellow slant was observed for isolates T1 and T5 of sample 2 indicating lactose or sucrose fermenting. 7 out of 20 isolates were found to be TSI positive.

1.4.4 Methyl Red Test:

After incubation at 37°C for 48 hours, methyl red was added into each inoculation. The isolate T1 of sample 2 and M3 M6, M9, M10 of sample 1 gave bright red colour that indicated a pH of 4.2 or less and hence the samples are methyl red positive. The isolates T2, T3, T4, T5, T6, T7, T8, T9, T10 of sample 2 and M1, M2 isolates of sample 2 showed yellowish orange colour indicating they were methyl red negative. Isolates T5 of sample 2 and M4, M5, M7, M8 of sample 1 presented reddish orange that indicated weak methyl red positive.

1.4.5 VP Test:

The Voges-Proskauer test detects the presence of acetoin, a precursor of 2,3 butanediol. Isolates M3, M4, M5, M9 of sample 1 and the isolate T5 of sample 2 gave a pink-crimson colour that indicated the presence of acetoin and hence were VP positive.

1.4.6 Catalase and oxidase assay:

Isolates M1, M3, M4, M6, M7, M8 of sample 1 and T1, T2, T3, T10 of sample 2 gave positive results that indicated these bacteria producing catalase enzyme that rapidly degraded H_2O_2 . The isolates M3, M9, M10 of sample 1 and T1 of sample 2 gave oxidase positive results. This indicated that these samples produced cytochrome oxidase enzyme that catalysed the oxidation of reduced cytochrome by molecular oxygen forming H_2O or H_2O_2 .

1.4.7 Citrate Assay:

In absence of glucose or lactose, some microbes use citrate as carbon source which depends on presence of citrate permease enzyme. Isolates M1, M2, M3, M4, M5, M6, M7, M8, M10 of sample 1 showed blue colour that indicated these microbes were citrate positive due to their ability to produce citrate permease enzyme, whereas all isolates of sample 2 were observed to be citrate negative. The summary of the results of biochemical test carried out for the isolates are presented in Table 3 and Fig 3.

Table 3: Summary of biochemical tests performed and identified bacteria

Isolates	Catalase test	Oxidase test	TSI assay	Methyl red test	Citrate assay	VP test	Probable bacteria
M1	Positive	Negative	Negative	Negative	Positive	Negative	<i>Vibrio gazogenes</i>
M2	Negative	Negative	Negative	Negative	Positive	Negative	<i>Chrysomonas luteola</i>
M3	Positive	Positive	Negative	Positive	Positive	Positive	<i>Vibrio cincinnatienses</i>
M4	Positive	Negative	Negative	Positive	Positive	Positive	<i>Vibrio metschnikovii</i>
M5	Negative	Negative	Negative	Positive	Positive	Positive	<i>Staphylococcus intermedius</i>
M6	Positive	Negative	Negative	Positive	Positive	Negative	<i>Vibrio gazogenes</i>
M7	Positive	Negative	Positive	Positive	Positive	Negative	<i>Flavimonas oryzihabitans</i>
M8	Positive	Negative	Negative	Positive	Positive	Negative	<i>Vibrio gazogenes</i>
M9	Negative	Positive	Positive	Positive		Positive	<i>Micrococcus mucilaginous</i>
M10	Negative	Positive	Positive	Positive	Positive		<i>Salomonella sp.</i>
T1	Positive	Positive	Positive	Positive	Negative	Negative	<i>Micrococcus luteus</i>
T2	Positive	Negative	Negative	Negative	Negative	Negative	<i>Staphylococcus simulans</i>
T3	Positive	Negative	Positive	Negative	Negative	Negative	<i>E. coli</i>
T4	Negative	Negative	Positive	Negative	Negative	Negative	<i>Photobacterium angustum</i>
T5	Negative	Negative	Positive	Positive	Negative	Positive	<i>Streptococcus group E</i>
T6	Negative	Negative	Negative	Negative	Negative	Negative	<i>Pseudomonas mallei/ Salmonella paratyphi</i>
T7	Negative	Negative	Negative	Negative	Negative	Negative	<i>Salmonella Paratyphi/ Pseudomonas mallei</i>
T8	Negative	Negative	Negative	Negative	Negative	Negative	<i>Pseudomonas mallei/ Pseudomonas paratyphi</i>
T9	Negative	Negative	Negative	Negative	Negative	Negative	<i>Salmonella paratyphi/ Pseudomonas mallei</i>
T10	Positive	Negative	Negative	Negative	Negative	Negative	<i>Klebsiella pneumoniae</i>

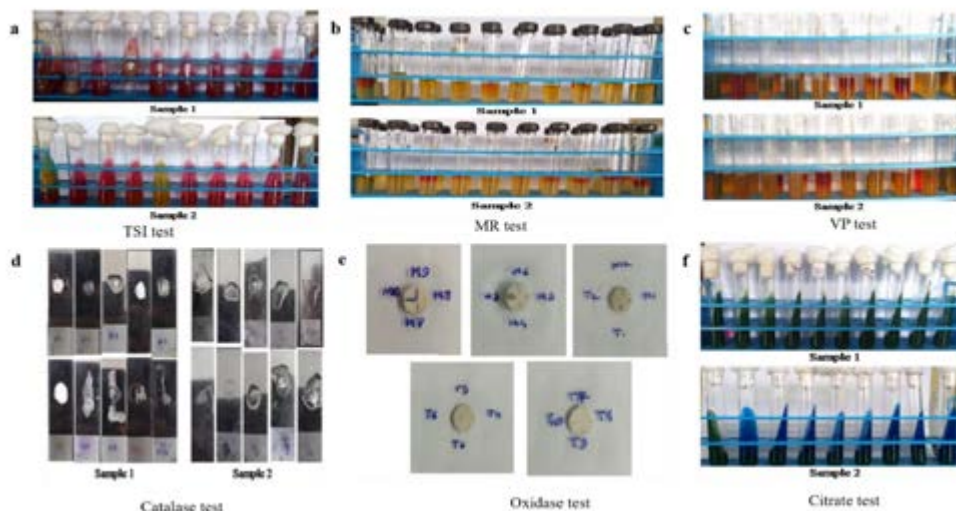


Fig 3. Representative pictures of the biochemical tests

1.4.8 Antibiotic Susceptibility by Kirby's disk diffusion assay:

The antibiotic diffusion plates were observed for the zone of inhibition after 24 hrs incubation. The summary of the susceptibility of the isolates to various antibiotics is presented in Table 4 and Fig. 4.

Table 4: Antibiotic disk diffusion assay results

Isolates	Ciprofloxacin (5mg)	Penicillin G (10mg)	Ceftizoxime (30 mg)	Gentamycin (10 mg)	Vancomycin (10 mg)
T2	S*	R*	R	R	S
T4	S	R	I*	S	I
T7	S	R	S	S	I
M3	S	R	R	S	S
M9	S	R	R	I	R

*S: Susceptible * I: Intermediate *R: Resistant

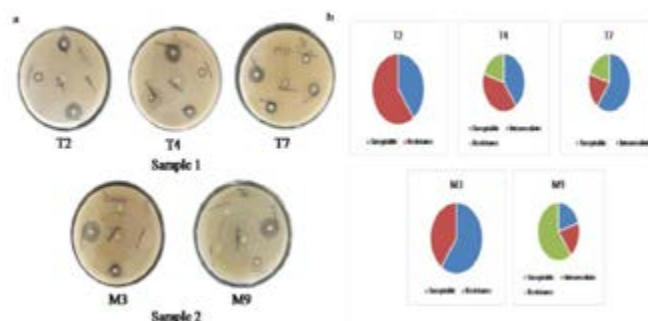


Fig 4. Antibiotic disc diffusion assay (a) and the pie chart showing the susceptibility pattern of the isolates to various antibiotics used in the study (b).

1.5 Conclusion

Various genera of bacteria were presumptively identified from Sample 1 and Sample 2. Pathogenic strains such as *Vibrio gazogenes*, *Chrysomonas luteola*, *Flavimonas oryzihabitans*, *Micrococcus luteus*, *Salmonella* sp. and *Salmonella paratyphi* which are known to cause diseases such as vibriosis, cholera, sepsis, bacteraemia, typhoid, pneumonia and others have been presumptively identified.

Among the isolates, T2 of sample 2 and M9 of sample 1 were found to be resistant to 3 different antibiotics. The isolate T2 of sample 2 was found to be resistant to penicillin, ceftizoxime and gentamycin and the isolate M9 of sample 1, a Gram-positive bacterium was found to be resistant to vancomycin, ceftizoxime and penicillin with gentamycin showing little to no effect. Four out of five isolates tested for antibiotic resistant were found to be resistant to penicillin. The isolate M9 of sample 2 has the potential to cause serious diseases as vancomycin resistant attribute makes it a formidable strain. Further research is required to quantitatively assess their characteristics. The possible diseases that may be caused by the bacteria isolated from sample 1 and sample 2 is provided in Table 5.

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Table 5: Bacterial isolates identified and the possible related diseases

Bacteria	Diseases
<i>Vibrio gazogenes</i>	Vibriosis and cholera
<i>Chrysomonas luteola</i>	Bacteraemia, meningitis, prosthetic valve endocarditis, peritonitis
<i>Vibrio metschnikovii</i>	Peritonitis, inflamed gall bladder, cholecystitis
<i>Staphylococcus intermedius</i>	Urinary tract infection, bacteraemia in dogs
<i>Flavimonas oryzihabitans</i>	Sepsis, peritonitis, endophthalmitis, bacteraemia
<i>Micrococcus mucilaginous</i>	Bacteraemia, endocarditis, ventriculitis, peritonitis, pneumonia, endophthalmitis, keratolysis, septic arthritis..
<i>Salomonella</i> sp.	Fever, abdominal pain, diarrhoea, nausea and sometimes vomiting.
<i>Micrococcus luteus</i>	Septic shock
<i>Staphylococcus simulans</i>	Cardiac or osteoarticular infections in dogs
<i>E. coli</i>	Urinary tract infections, respiratory illness and pneumonia
<i>Photobacterium angustum</i>	Pathogen of marine life
<i>Streptococcus group E</i>	Soft tissue infections such impetigo and cellulitis.
<i>Pseudomonas mallei</i> / <i>Salmonella paratyphi</i>	Typhoid fever
<i>Klebsiella pneumoniae</i>	Urinary tract infection (UTI), pneumonia, intra-abdominal infection, bloodstream infection (BSI), meningitis and pyogenic liver abscess (PLA)

It is important to understand the vast presence of microbes in everyday objects. Creating awareness about hygiene and the lurking dangers present in everyday objects is of utmost importance especially in times of pandemic as secondary infections by opportunist pathogens can be lethal apart from the dangers of primary infection existing in an host.

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Topotecan and (22S)-Budesonide as potential Drug candidates against ORF3a in SARS-CoV-2 virus

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Abstract

SARS-CoV-2 is a positive-sense single-stranded RNA virus covered in a spiked glycoprotein envelope which acts as a causative agent for COVID-19. SARS-CoV-2 ORF3 gene encodes a novel structural protein ORF3a whose actual mechanism and functions are still unclear. According to the recent findings, ORF3a protein forms an ion channel and modulates viral release. Not only the mode of viral entry but its replication and release play a major role in increasing the copy number of the virus. The study involves finding an effective drug that can bind to the active pocket of ORF3a protein to reduce the viral load. In our work, we have used in silico techniques to screen FDA-approved drugs. 164 screened molecules that obey the screening filters were further ranked based on their binding affinity to ORF3a protein. Topotecan and (22S)-Budesonide showed favourable binding energy of -11.85 and -9.4 kcal/mol with the target protein ORF3a. For both the top-scoring compounds the clustering RMSD was found to be 0.00 and an estimated Inhibition Constant (K_i) was found to be 3.90 nM and 242.88 nM.

Keywords: Glycoprotein, Replication, Insilco, Lipinski, Toxicity, Grid.

Introduction

Covid-19 has brought a severe threat to humanity throughout the globe. This pandemic started at the end of the year 2019 in Wuhan city, China and gradually it spread all over the world (Chen *et al.*, 2020). Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the causative agent for coronavirus disease (COVID-19) (Hui *et al.*, 2019). Based on the viral genetic constitution coronaviruses are classified into four main subgroups- alpha, beta, gamma, and delta (Harvey *et al.*, 2021). A novel strain of SARS-CoV-2 belongs to the β -coronavirus family which includes a large class of viruses that are prevalent (Guo *et al.*, 2020). SARS-CoV-2 are diverse and can find a wide range of hosts as primary, intermediate and final hosts for their multiplication, which make it very difficult to control the disease transmission rate. The propensity of this virus to

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transmit and replicate across species can be one of the reasons for the outbreak of the diseases (Cui *et al.*, 2019). The global mortality rate for SARS-CoV-2 is much higher as compared to SARS and Middle East respiratory syndrome coronaviruses (MERS-CoV) respectively (Banerjee *et al.*, 2020). According to recent studies in China SARS-CoV-2 has a relatively high transmissibility rate, 87% of the cases were aged between 30–79 years (Wang *et al.*, 2020).

SARS-CoV-2 contains as many as 14 open reading frames (Orfs) The 5' Orf1a / Orf1ab encodes polyproteins, which are auto-proteolytically processed into 16 non-structural proteins (Nsp1-16) which form the replicase / transcriptase complex (RTC) (Vlachakis *et al.*, 2020). The RTC consists of multiple enzymes, including the papain-like protease (Nsp3), the main protease (Nsp5), the Nsp7-Nsp8 primase complex, the primary RNA-dependent RNA polymerase (Nsp12), a helicase/triphosphatase (Nsp13), an exoribonuclease (Nsp14), an endonuclease (Nsp15), and N7- and 2'O-methyltransferases (Nsp10/Nsp16)1,16,17 (Kangarshahi *et al.*, 2021). At the 3' end of the viral genome 13 Orfs are expressed from nine predicted sub-genomic RNAs which includes four structural protein as Spike (S), Envelope (E), Membrane (M) and Nucleocapsid (N) 17, and nine putative accessory factors (Fehr & Perlman 2015). There are lots of similarities in the genomic sequences between SARS-CoV and SARS-CoV-2 but the detectable changes in the Orf3b and Orf10 with limited detectable protein homology to SARS-CoV (Jungreis *et al.*, 2021), and its Orf8 is intact while SARS-CoV encodes Orf8a and Orf8b (Zandi, M. 2021). The earlier study reported that ORF3a encoded by SARS-CoV induce apoptosis in the host cells (Law *et al.*, 2005). Host cells in response to the viral infection use apoptosis as a defence mechanism to control the viral transmission from one cell to another. A similar comparative experiment done in ORF3a from SARS-CoV-2 showed that it can induce apoptosis however the magnitude of apoptosis is reduced in comparison to ORF3a from SARS CoV (Bianchi *et al.*, 2021). Since the antiviral defence from the infected host cell is reduced, infection is either asymptomatic or mild, thus allowing the deadly SARS-CoV-2 to spread rapidly (Yujie *et al.*, 2020). ORF3a is a viroporin ion channel that has N-terminal, transmembrane & 8-stranded β barrel C-terminal domain (Issa *et al.*, 2020). The study showed that this ion channel may promote the release of the virus and regulate the viral cycle (Padhan *et al.*, 2007). To treat the covid infected individual instantly, the National Institute of Health (NIH) has recommended a few drugs such as etesevimab & bamlanivimab etc. FDA has approved remdesivir (Wang *et al.*, 2020). However, remdesivir cannot be used in patients with severe hypoxia conditions (Beigel *et al.*, 2020), as consequence research for new drugs and an effective mode of drug delivery system is the prime need in the current situation. In this research work, attention has been mainly focused on the drug (22S)-Budesonide (a non-halogenated glucocorticoid generally used

as an anti-inflammatory drug to treat asthma and pulmonary diseases) (Zetterstrom *et al.*, 2001) and its interactions specifically with the target protein ORF3a. The study conducted by Ramakrishnan *et al.*, in the year 2021 showed that after inhaling 1.6 mg of budesonide in moderately infected covid-19 patients, recovery time has been reduced significantly. A non-covalent reversible inhibitor against ORF3a protein has the potential to become a new drug with few or no side effects for the control of the devastating effect of SARS-CoV-2.

Materials and methods

Retrieval and preparation of ORF3a protein

The structure of SARS-CoV-2 ORF3a solved by cryo-electron microscopy was obtained from the Protein Data Bank (PDB) with a resolution of 2.90 Å. The three-dimensional (3-D) structure was used to test for the presence of water molecules, ions, and heteroatoms in the structure before they were removed. Simulated Annealing algorithm was used and the optimal amount of hydrogen atoms and Kolmann charges were applied to the ORF3a protein including the atomic coordinates, partial charges, and solvation parameters for all atoms in the macromolecule.

Preparation of the FDA approved drugs

A drug server was used to retrieve all 1930 FDA-approved medicinal compounds, and ChemSketch was used to construct three-dimensional structures for the ligands available in the two-dimensional structure, and the structures were minimized using Avogadro algorithm, version 1.2.0.

Screening of the FDA approved drugs

All the 1930 compounds were screened based on their chemical properties as well as their affinity towards the protein receptor ORF3a based on the Lipinski rule of five and toxicity parameters (Mutagenic, Tumorigenic, Reproductive effects, and irritants).

Molecular interaction studies based on binding energy

Molecular interaction studies were carried out using Lamarckian, Simulated Annealing algorithm. The protein complexes were visualized using Discovery studio visualizer. Interacting residues were determined using LigPLOT⁺ algorithm, version 2.2.

Results and discussion

Screening of the ligand molecules based on ligand affinity

Out of 1930 FDA-approved drugs the discontinued drugs were removed, 164 molecules

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passed through the Lipinski's filters and none of them was found positive for toxicity characteristics. Broyden-Fletcher-Goldfarb-Shanno algorithm was used for virtual screening which was performed blindly considering the whole protein molecule in a grid with both the chains (Grid dimensions: Center X=143.8427, Y=143.0602, Z=154.1643; Dimensions (Å): X=52.35362, Y=51.5386, Z=96.8385). The highest ligand affinity was found to be -8.2 kcal/mol with a clustering RMSD value of 0.00 for Ezetimibe, -8 kcal/mol for Meloxicam, -7.7 kcal/mol for topotecan, -7.6 kcal/mol for (22S)-Budesonide.

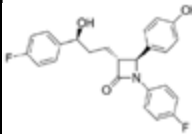
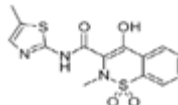
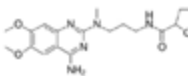
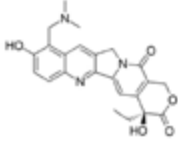
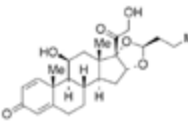
Molecular interaction studies using Binding energy

A new pocket specific gridbox was defined from the ORF3a and Ezetimibe complex using AutoDock Tools-1.5.6 (Grid dimensions: number of points in dimension X=36, Y=40, Z=38; Center (Å): X=150.046, Y=136.174, Z=153.078; Spacing (Å): 0.375) from the previously achieved highest score from Broyden-Fletcher-Goldfarb-Shanno algorithm (autodock vina, Trott, O. and Olson, A.J. 2010) screening of Ezetimibe. The best-scored compound was re-docked using Lamarckian, Simulated Annealing algorithm (autodock) which showed binding energy as -8.2 kcal/mol with an estimated Inhibition Constant (K_i) of 982.85 nM, for Meloxicam the binding energy was found to be -5.9 kcal/mol, -5.9 kcal/mol for Alfuzosin, for topotecan the binding energy was found to be -11.85 kcal/mol and for Budesonide it was found to be -9.4 kcal/mol. The scores for top lead compounds are shown in Table 1.

The propensities and the positioning of the different amino acid residues contribute to the overall stability and the architecture of the protein structure. Several different amino acid residues which are involved in the formation of the molecular pore and its stabilization are illustrated in Fig. 1A. Amino acid residues which are important as a clipper of the dimeric chains and their stability are shown in Fig. 1B and 1C. The active pocket with all the interacting residues is shown in Fig. 1D. The Ramachandran plot analysis shows that 89.2 % of the overall structure falls under the most favoured region providing a major topology for the small molecule to interact with the protein ORF3a (Fig. 1E).

In the topotecan ORF3a complex, there were two major hydrogen-bond interactions involving Arg87 and His39 respectively from the chain A of ORF3a protein (Fig. 2C). The non-bonded interactions that further stabilize the receptor-ligand complex involve Arg83, Asp103, Tyr161, Ser214, Lys215, Ile217, Thr218, Leu219, and His232 of ORF3a (Fig. 2C). Similarly, amino acid residue Lys36 of ORF3a was found to form a hydrogen bond with the compound Budesonide (Fig. 3C). The non-bonded interactions that further stabilize the receptor-ligand complex involve Lys22, His39, Asp103, Ile217, and His232 of ORF3a (Fig. 3C). The active pocket with all the interacting residues is shown in Fig. 2B & 3B respectively.

Table.1. Showing top 5 screened molecules that are carried further for molecular interaction studies

Sl No	Drug name	Binding affinity (kcal/mol)	Binding energy (kcal/mol)	Clustering RMSD	Inhibition Constant (Ki)	Pose for Binding energy	2-D Structure
1.	Ezetimibe	-8.2	-8.2	0.00	982.85 nM	5 th	
2.	Meloxicam	-8	-7.81	0.00	1.87 uM	1 st	
3.	(R)-Alfuzosin	-7.9	-5.9	0.00	259.03 uM	8 th	
4.	Topotecan	-7.7	-11.85	0.00	3.90 nM	2 nd	
5.	(22S)-Budesonide	-7.6	-9.4	0.00	242.88 nM	5 th	

Topotecan and (2S)-Budesonide as potential Drug candidates against ORF3a in SARS-CoV-2 virus

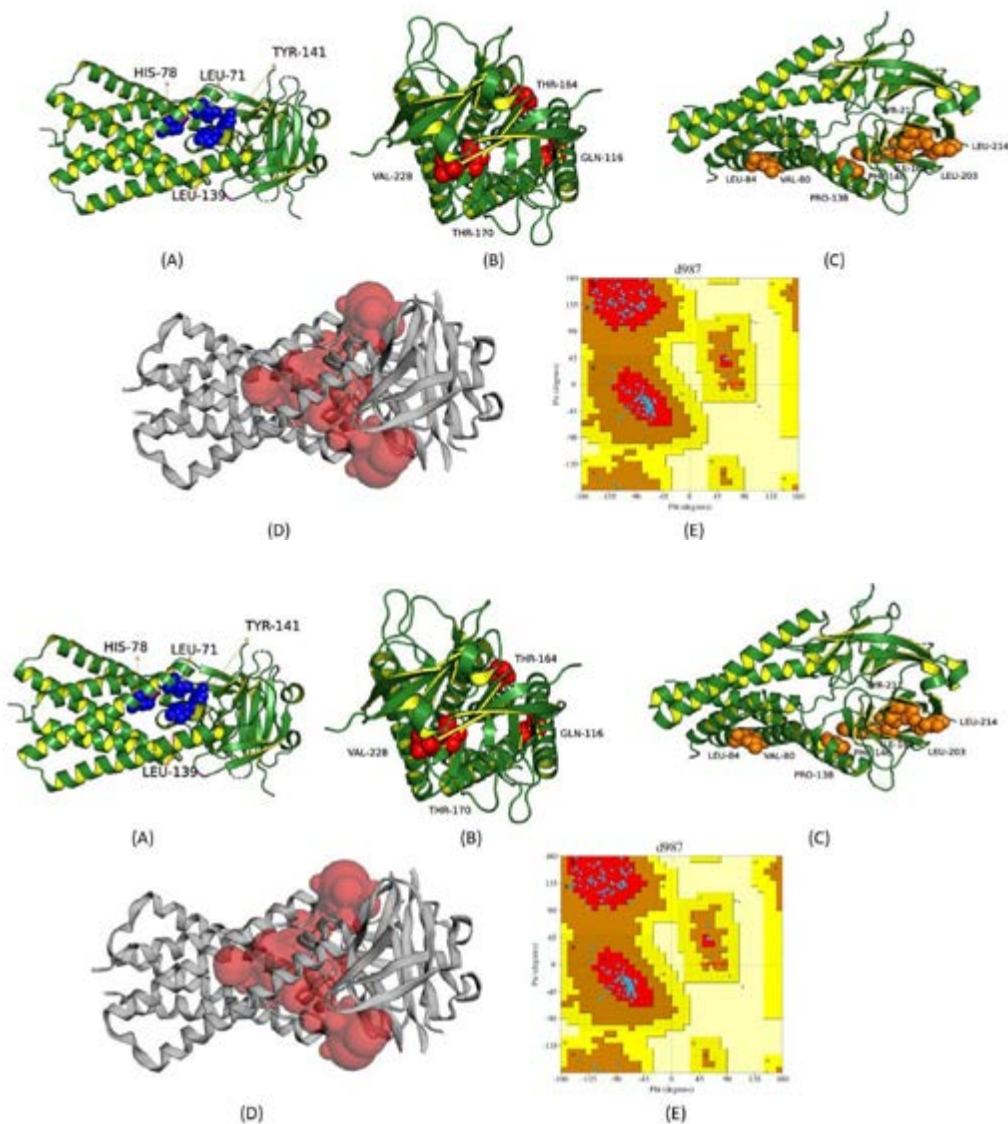


Fig. 1. (A) Showing the amino acid residues (Leu71, His 78, Leu 139 and Tyr 141) that are responsible for the pore and tunnel stabilization (B) The amino acid residues (Gln 116, Thr 164, Thr 170 and Val 228) which are highly conserved and help in the dimer formation between chain A and B (C) The amino acid residues (Gln 80, Leu 84, Pro 138, Phe 146, Ile 169, Leu 203, Tyr 212, and Leu 214) which contribute to the structural stability and uniformity supported by Intra-monomer interactions (D) Amino acid residues that form the active site for ORF3a protein determined by Computed Atlas of Surface Topography of proteins (CASTp) (E) Representing the Ramachandran plot for the ORF3a protein with 89.2% of Most favoured regions and 10.2% of Additional allowed regions.

Fig. 2. (A) Structure of ORF3a bound to Topotecan. (B) The binding pocket of ORF3a with the interacting compound topotecan. (C) A 2-dimensional representation of topotecan with the interacting residues of ORF3a.

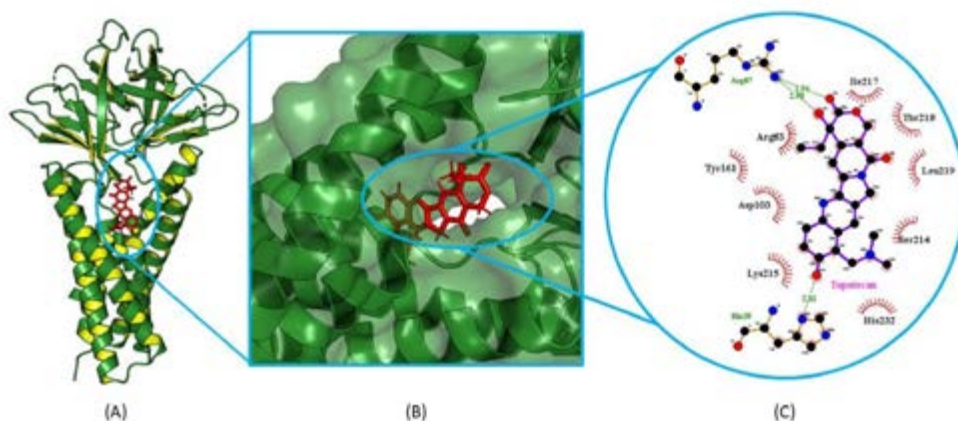
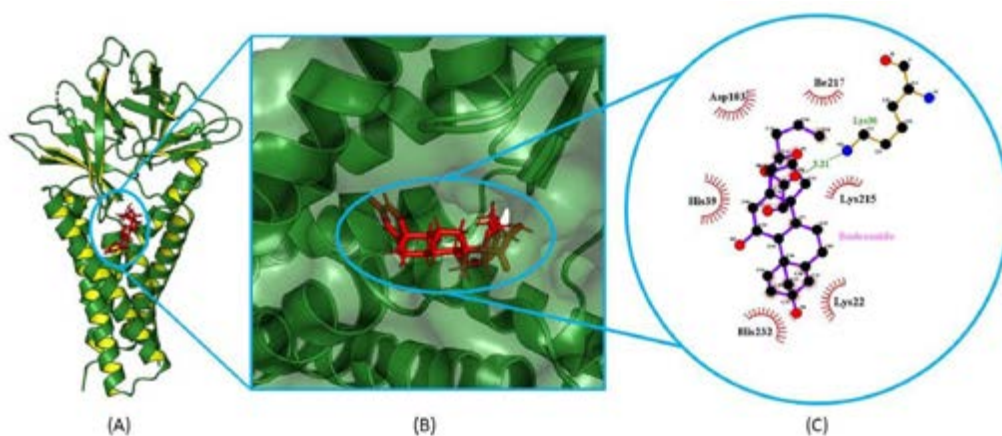


Fig.3. (A) Structure of ORF3a bound Budesonide. (B) The binding pocket of ORF3a with the interacting compound Budesonide. (C) A 2-dimensional representation of Budesonide with the interacting residues of ORF3a.



Conclusion

The main purpose of this study was to establish a strong binding of an applied drug with the ORF3a protein of SARS-CoV-2. (22S)-Budesonide which was previously used as inhalers for the treatment of asthma and chronic obstructive pulmonary disease (COPD) and Topotecan which was known as the anti-cancerous drug has shown promising interaction scores. According to WHO, list of essential medicines, (22S)-Budesonide has been listed as one of the safest and the most effective medicine. The inhibition constant (K_i) of this drug was found to be 242.88 nM which shows the effectiveness of the drug for its administration. It is therefore necessary to take these studies further for wet bench experimentation to check the effectiveness of these drugs for the treatment of COVID-19.

Acknowledgements

The authors are thankful to the Department of Biotechnology and Bioinformatics and the *supercomputing facility*, North-Eastern Hill University, Shillong for providing the research infrastructure for carrying out the computational work.

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Place of Publication	: NEHU Permanent Campus Shillong-793022
Periodicity	: Biannual
Printer's Name	: Editor, NEHU Journal
Address	: Permanent Campus Shillong-793022
Publisher's Name	: Editor, NEHU Journal
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