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Review Article

Betalain as a Food Colorant: its Sources, Chemistry and Health Benefits

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Abstract: Food colors are essential ingredients of modern processed foods. Betalain can be used as a natural color source for various foods due to its nutritional and safety value. This natural and water soluble dye occurs either as red-violet betacyanin or the yellow-orange betaxanthins. Betalain plays a vital role in human health due to its pharmacological activities such as antioxidant, anti-lipidemic, antimicrobial, antitumor, antiviral and anticancer potential. There are many eatable sources of betalain e.g., Opuntia stricta (cactus fig), Opuntia ficus-indica (barbary fig), Beta vulgarius (red beet), Amaranathus tricolor (Amaranath), Celosia argentea (silver cock's comb) and Chenopodium quinoa Wild. Red beetroot provides carotenoids, glycine, betanin, saponins, betacyanin, folates, polyphenols and flavonoids. Amaranthus is an important source of vitamin C, vitamin B, soluble fiber, betacyanin and shows significant antimalarial and antimicrobial activity. Celosia argentea Linn provides carbohydrates, vitamins, dietary minerals and high amount of betalain. *Chenopodium quinoa* contains high content of vitamins and minerals. Betalain of Opuntia ficus-indica fruits (barbary fig) possesses strong anti-proliferative activity. Extract of prickly pear (cactus fig) pulp which contains betalain, can act as an antibiotic agent in cases of wounds, digestive and urinary tract infections and inflammations. It also has significant inhibitory effect against humanoid ovarian tumor and cervical cancer cells. Optimum pH for maximum stability of betanin lies between pH 5.5 and 5.8. Betalain stability is affected by long term exposure to oxygen/air, light in the presence of oxygen, high temperature and water activity (aw) but it is highly stable in the presence of low moisture.

Keywords: Food color, Betalain, Betacyanin, Betaxanthins, Pharmacological, Health

1. INTRODUCTION

Color is the most important feature which may effect on the acceptability of a consumer for food items [1, 2]. To enhance the visual attraction of food products, many artificial colors are used in processed foods e.g., candies, soft drinks, sweets and in some prepared dairy products such as cheese and butter [3]. However, some of these artificial food colors may cause allergic responses in children while their long term use results in carcinogenic diseases [4]. Consequently, the consumers have started to avoid the commodities containing synthetic colors while the plant pigments are gaining special attraction [5]. Pigments are the plant compounds which are perceived by human beings due to their specific colors [6]. Their varieties of colors and structures have also attracted the attention of biologists and

chemists [7]. In addition to their fascinating colors, the plant pigments also possess nutritional value and health promoting affects [8, 9] and are also considered environment friendly [10]. Betalains are water soluble nitrogenous pigments of plant nature [4, 11,12] and exist mostly in florets, fruits and in vegetative tissues of plants [13]. They are comprised of either yellow (betaxanthins) or red (betacyanins) pigments and their main sources are the beetroots [14, 15]. They contain a group of molecules which are responsible for the red hue of red beet juice [16] and are currently gaining popularity in the food industry [17]. Betanin (a betalain in beetroot) has been recommended as a natural red colorant for use in pharmaceutical and food items. This pigment also possesses healthpromoting properties and antioxidant potential; it also displays peroxy-radical scavenger potential in

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pork meat and can be used as an attractive colorant in frozen or refrigerated foods. Its high antioxidant ability is retained even after simulated digestion in small intestine. Organisms can be protected from oxidative stress by long-term supplementation from beetroot [18]. The present studies focus on the chemistry of betalain and its uses as a natural colorant in food products.

2. SOURCES OF BETALAIN

There are many eatable sources of betalain (Fig. 1) [19] which include red and yellow beetroot, leafy amaranth, cactus fig, Barbary fig, silver cock's comb etc. *Phytolacca americana* Linn (pook weed) is another source of betalain, but it has been banned as a food colorant due to the presence of toxic saponins and lectins. Betalain pigment is not only found in edible plants but it can also be obtained from leaves, pulp and stem of plants [20]. Betalain plays a vital role in human health due to its pharmacological activities such as anti-cancer, antimicrobial, anti-lipidemic and antioxidant activities.

Red beetroot is grown all over the world as a source of food and red dye. The color of red beetroot is due to the presence of red betacyanin and yellow betaxanthin pigments which are placed in betalain or betanin compounds group [21]. Red beet provides carotenoids, glycine, betanin, saponins, betacyanin, folates, polyphenols and flavonoids [22]. Betalain pigments display an excellent antioxidant and antimicrobial potential [23].

Amaranthus is an herbaceous plant which possess very high amount of betalain pigments. It belongs to family Amaranthaceous; the word Amaranthus is derived from a Greek word which means flower. This plant is also an excellent source of vitamin C, vitamin B, soluble fiber and betacyanin; it shows antioxidant activity higher than ascorbic acid [24].

Celosia argentea commonly known as silver cock's comb, is an herbaceous plant which belongs to tropical regions. The word *Celosia* was derived from a Greek word Kelos which means "burned, burning"; this name was given due to the color of inflorescences (orange, red and yellow), specially for *P. plumosa*, which resembles flames erupting from the stems [24, 25]. *Argentea celosia* provides carbohydrates, vitamins, dietary minerals and huge amount of betalain. This plant is commonly grown for ornamental purposes and finds applications in medicinal field as well. The color of *C. Argentea*



Fig. 1. Several plants containing betalains. (A) *Portulaca oleracea* L. flowers (B) *Gomphrena globosa* L. flowers (C) *Echinopsis tubiflora* flowers (D) *Dianthus caryophyllus* L. flowers and stems (E) *Mirabilis jalapa* L. flowers (F) *Beta vulgaris* L. whole plants (some pictures from pexels.com) [19]

varies from yellow to many other shades like violet and red, especially for the garden *Celosia* (plumose and cristata); these colors are owed to the presence of betalains [24, 26].

Chenopodium quinoa is herbaceous and flowering plants which belong to Amaranthaceae family. The word Chenopodium was derived from the Greek words chenos (meaning goose) and podos (meaning foot). This plant contains vitamin B, dietary minerals and has very high amount of betacyanin and betaxanthins pigments. All these plants have medicinal applications in inflammation, digestive and urinary tract [24].

3. CHEMISTRY OF BETALAIN

Betalains may either be in the form of betacyanin (red-violet pigment) orbetaxanthins (yellow-orange pigment). It is discovered that betalains may act against microbes/viruses and also hinder the growth of tumor cells in human. Betalain obtained by extraction from beetroot is also known as "beetroot red"; however, it may be degraded soon after its extraction. There are several factors which influence the pigment stability for example; temperature, enzymes, pH and oxygen [27]. Betalain pigments show more stability towards pH and temperature while they are suitable to those foods in which anthocyanin cannot be used as a coloring agent due to low-acid conditions [28].

Betalains are derived from betalamic acid (Fig. 2) [29]. Betalamic acid and amino acids or amines are condensed to form betaxanthins; glutamine-betaxanthins (vulgaxanthin) is the most common betaxanthin which occurs in red beet (Beta vulgaris Linn). While in yellow cactus pears (Opuntia sp.) indicaxanthin is present dominantly. Betacyanins, due to their deep violet color, are considered to be the condensation products of betalamic acid and cyclo-dopa [cyclo-3-(3,4dihydroxyphenylalnine)]. Various betacyanin structures can be obtained as a result of glycosylation with one or two monosaccharaides and as a result of acylation of the resulting 5-O- or 6-O-glucosides [30].



Fig. 2. Structures for betalamic acid, the betacyanins aglyca (betanidin), and the general structure for betaxanthins. R_1 and R_2 are lateral residues present in amines or amino acids. For comparative purposes, the structure for the diphenolic betaxanthin Miraxanthin V is also shown together with resveratrol and cyaniding [29].

4. BETALAINS AS COLORANTS

Betalains are produced from amino acids (tyrosine) and occur in two structural forms; the red-violet betacyanin and the yellow-orange betaxanthins. All betalain pigments contain a common chromophore betalamic acid which is used to classify betalain pigment into betacyanin and betaxanthins on the basis of other structural differences. Betacyanin contains a cyclo-3, 4-dihydroxyphenylalanine residue. The condensation with the closed structure of cyclo-dopa extends the electronic resonance to the phenolic aromatic ring. This extra conjugation shifts the absorption maximum from 480 nm (yellow, betaxanthins) to 540 nm (violet, betacyanin). The betacyanin is more brighter in color as compared to the red radish anthocyanin and have almost the same color stability during the initial 4-weeks storage (≤ 25 °C) or during 20-weeks storage $(\leq 14 \text{ °C})$. However, less stability of betacyanin was observed at 37 °C as compared to the red radish anthocyanin [31].

5. MICROENCAPSULATION OF BETALAIN

A bioactive compound could be protected from oxygen and water and its stability could be improved by using microencapsulation technique. There are several benefits of encapsulation such as; easier handling, prevention of lumping, compression and mixing properties, improvement in flow ability, reduction in core particle dinginess and modification of atom concentration. It is also helpful in increasing shelf life of some natural dyes like betalain [32].

6. FACTORS AFFECTING BETALAIN STABILITY

Stability of betalain pigments is of great importance. There are some factors which affect the color stability of betalain

6.1 pH

Optimum pH for maximum stability of betanin lies between pH 5.5 and 5.8 in the presence of oxygen. Betalains extracted from Amaranthus species exhibit maximum stability at pH 5.0-7.0 at 25°C [33]. Betacyanin of *Opuntia* shows thermal stability at pH 5 [32] and those obtained from beetroot are normally stable at pH 5.5. The betanin solution in the presence of nitrogen has highest stability at pH 4.0-5.0. The degradation of betaninin solution is reversible [34]. There were investigations on the partial regeneration of betanin after heating and the results showed that amount of regeneration of the pigment depends upon the pH of the sample [35]. The maximum regeneration of betanin is affected by the storage temperature and the type of buffer solution. Under low oxygen levels, the heated betalain solution (pH 4.75, 130 minutes, 15 °C) has shown the increase in betanin retention from 54% to 92% [36].

6.2 Water Activity

The stability of betalain is affected by water activity (aw) which is considered to be a primary factor in color degradation. The pigment stability is exponentially related with moisture content and water activity (aw); the low aw means higher stability of pigment. The stabilities of beet pigments (vulgaxanthine-1 and betanin) were affected by moisture content and water activity ("dry"– 0.84) in the beet powder stored at 35°C. When aw was increased from 0.32 to 0.75, the pigment stability was decreased by one order of magnitude. However, the betalain pigments showed no degradation when the beet powder was stored at aw 0.12 or below for even a period of several months [37].

6.3 Oxygen

The oxidation is an important reason of darkening and color loss of fruits and vegetables. Oxygen causes the degradation of color pigments and hence the loss of original color of a product. Buffered betalain solutions were kept at pH 7 in the presence of nitrogen and air for 6 days at 15°C. It was concluded that about 15% degradation of color was occurred only due to the presence of air [35]. The results were further verified when the pigments were degraded in the saturated solutions of air due to the reaction of betalain with molecular oxygen. Betalain and betalain pigments are considered to be unstable in the presence of oxygen. The betalain stability is decreased linearly when oxygen concentration is increased. In addition to oxygen, hydrogen peroxide is also a cause of pigment degradation. However, the betalain stability is considered to be increased in the presence of nitrogen atmosphere [35].

6.4 Light

Light is another important factor which effects on the degradation of betalain pigment [36]. Presence of light shows disastrous effects on betalain degradation at temperature lower than 25°C while there was no effect of light above 40°C. Light-induced betalain degradation was occurred after absorption of light in UV and visible range; this absorption resulted in electron excitation of betalain pigment to a more excited state and caused higher reactivity and lower activation energy of the molecule. The combined effects of oxygen and light were also observed. Light and oxygen independently have shown the degradation of betanin up to 15.6% and 14.6%, respectively. However, the combined availability of both light and oxygen has shown about 28.6% degradation of the pigment [36]. The degradation of pigments by light depends on the presence of oxygen because this degradation is very low in the absence of oxygen even when light is present [35].

6.5 Temperature

Temperature plays a vital role in the stability of betalain as far as food processing and storage is concerned [33]. Betalains are heat sensitive pigments so they lose their stability at higher temperatures. The degradation of betalain is increased with increase in temperature and time period of heating. A considerable decrease in betalain stability was observed at 50-60°C and also between 70 to 80°C [38]. Thermal degradation of betalain is of great concern because many heat treatment processes are being used to ensure the safety and quality of various food products. Thermal stability of betalain depends on heating time and temperature as well as some other factors such as light concentration and structure of the pigment [33].

7. SOCIAL AND ECONOMIC USES OF BETALAIN

Betalain can be used as a foodcolor in food industry and agro industry. *Beta vulgarius* (red beet), *Amaranathus tricolor* (Amaranath) and *Celosia argentea* (silver cock' scomb) are those plants which produce betacyanin commonly used in food, medicine and also in oil for diet supplementary and soap. They are also used as decorative plants [39].

8. HEALTH BENEFITS OF BETALAIN

The betalain as a food colorant may have high beneficial effects on health due to its valuable ingredients and natural resources. The pharmaceutical and nutritional value of extracts of plants has been well recognized in early reported literature [40-42]. Betalain also shows pharmacological activities including antioxidant activity, antimicrobial activity, anti-cancer activity as well as other activities. The antioxidant activity of betalain can be verified through different chemical and biological methods. Betanin obtained from red beet is about 1.5-2.0-folds more active as compared to the some other anthocyanins which are considered excellent free radical scavengers as determined by Trolox equivalent antioxidant capacity (TEAC) assay at pH>4. This exceptionally higher antioxidant potential of betanin is due to increase of its electron-donation and H-donation ability in going from the cationic form to mon-, diand tri-deprotonated states present in basic solutions [43]. Betalain from Amaranath shows strong antioxidant activity than ascorbic acid as determined by DPPH assay. Betalain obtained from Opuntia ficus-indica fruits (Barbary fig) has strong antiproliferative activity against cancer cells. Extract of prickly pear (cactus fig) pulp containing betalain can be used as an antibiotic agent in digestive and urinary tracts, wounds and inflammation. It also shows considerable inhibitory effect on humanoid ovarian tumor and cervical cancer cells. Betalain from Amarnath shows significant antimalarial and antimicrobial activity [20]. It is worth mentioning that it is highly important to implement stricter quality control measures, regulatory initiatives, technical assistance and hygienic precautions in order to ensure the nutritional value of the food [44].

9. CONCLUSIONS

The color of food is a significant factor in determining its acceptance. However, to ensure the food safety, it is important to add up safe and healthy ingredients into the food products. The synthetic colors may cause some allergic reactions; their long term use is considered to be a cause of carcinogenesis. Betalains have some properties which are beneficial to our health due to which they can be used to enhance the flavor and color of ice cream, jellies, jams, desserts, sauces, sweets, tomato paste and breakfast cereals. Betalain contains antioxidants, antimicrobial agents and antiradical compounds which show the nutritional and safety significance of red dve as a natural source of color. There are many eatable sources of betalain e.g., cactus fig. barbary fig. Betalain occurs either as redviolet betacyanin or the yellow-orange betaxanthins and can be extracted from Beta vulgarius (red beet), Amaranathus tricolor (Amaranath), Celosia argentea (silver cock' scomb) and Chenopodium auinoa wild. Betalain stability is affected by long term exposure to oxygen/air, light in the presence of oxygen, high temperature and water activity (wa) but it is highly stable in the presence of low moisture. Its pigments show more stability towards pH and temperature and are suitable for those foods in which anthocyanin cannot be used as a coloring agent.

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Research Article

Anemia in Asthmatic Females Exaggerates the Severity of Inflammation in Asthma by Inducing Dyslipidemia, High levels of IgE and Absolute Eosinophil count

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Abstract: The objective of the study was to investigate the effects of anemia on severity of inflammation in asthmatic females with the assessment of dyslipidemia, IgE and absolute Eosinophil count. Study was performed at Pathology Lab of Asia Diagnostic Center, Blue area Islamabad Pakistan. Total 100 asthmatic Females (Group 1) and 100 normal females as control (Group 2) were enrolled in this study. Hemoglobin (Hb) levels, Total leukocyte count, Lipid profile, serum IgE and Eosinophil count were analyzed in Group 1 and Group 2. Group 1 was sub divided in to two groups. Group 1a asthmatic females with anemia and Group1b asthmatic females without anemia. Triglycerides (TG) and very low density lipoprotein (VLDL) with mean value 139.8 ± 27.9 and 23.6 ± 6 in Group 1a were not significantly different with p-value >0.05 from Group1bwith mean value of TG 137 ± 25.5 and VLDL 25.9 ± 5.8 . Cholesterol and low density lipoprotein (LDL) were significantly high in Group 1a than Group1b with p-value <0.05. HDL levels in Group 1a were significantly lower than Group1b with the p-value 0.017. Markers of severity of inflammation in asthma, IgE and Absolute Eosinophil Count were also high in Group 1a with p value 0.0297 and <0.0001 respectively from Group1b. The strongest negative correlations ware observed for LDL - 0.60. IgE - 0.61 and absolute eosinophil count -0.99 with Hb levels in Group 1a, which indicate that anemia exaggerate the severity of inflammation in asthma as well as dyslipidemia in anemic asthmatic females. From our study it was concluded that when anemia is present in asthmatic females it will exaggerate the severity of inflammation in asthma by inducing dyslipidemia, high eosinophil count and high level of IgE.

Keywords: Asthma, Anemia, Dyslipidemia, Female asthmatic patients, IgE, eosinophil.

1. INTRODUCTION

Asthma is a chronic disease. More than 300 million people are asthmatic worldwide [1]. The prevalence of asthma is high in females after the age of 18 years but the boys in childhood are more prone for asthma than young girls. Sex hormones plays important role in this switchover. Overall prevalence, severity, hospitalization and mortality rate is high in females than the males due to asthma [2]. Asthma is an inflammatory condition, associated with hyper responsiveness of airways and leads to repeated incidence of chest tightness, wheezing, breathlessness and coughing specially at night and morning [3]. T-helper cell immune response to various allergic substances like dust,

pollens, molds and non-allergic substances like smoke, cold air and infections are associated with airways tightness and asthma. Increased levels of T-helper cell in airways due to these allergic and non-allergic substances secret various cytokines which exaggerate eocinophilic inflammation and increase the production of IgE. Histamine and cysteinyl leukotrienes are produced due to inflammation in airway that cause bronchospasm and mucus production which leads towards asthma [4]. Prevalence of asthma is 4.3% in children and adults. Around 255,000 are died per year due to asthma. In Pakistani females, the prevalence of asthma is 12% which is going to be increased [5]. Serum IgE levels, eosinophil's counts, Fractional Exhaled Nitric Oxide (FENO) levels, and

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sputum eosinophil's counts are used to diagnose asthma [6]. Iron deficiency is also associated with asthma [7]. Iron deficiency (ID) and low serum ferritin have suspicious effects on lipids and sometime iron deficiency is associated with dyslipidemia that may cause atherosclerosis [8, 9]. ID is widespread nutritional disorder and also the common cause of anemia, regardless of age, gender and socioeconomic status. It is the most common cause of anemia. Iron deficiency anemia (IDA) is the one of major public health problem due to its complication. According to WHO about a third of the population of world is suffering from anemia with IDA [10]. Anemia is a condition in which 1 hemoglobin level is low below the reference range according to age and sex. According to WHO, the Hb levels in adult males <13g/dl, non-pregnant females <12g/dl and pregnant females <11g/dl are considered as anemic [11]. According to the Hb concentration in blood, anemia is classified in to mild, moderate and severe state. For females the range of mild anemia is 10-11.9 g/dl, moderate is 7-9.9g/dl and <7g/dl is consider as severe state of anemia [12]. Variation in lipid profile and risk of endothelial dysfunction are relatively high in asthmatic patients. The incidences of asthma are high in the anemic children and anemic females [13]. Eosinophil's and serum immunoglobulin E (IgE) are considered a good marker of airway inflammation and severity of inflammations in asthma [14]. Various studies also describe that prevalence of asthma is high in anemia. However the separate analysis of lipids, IgE and eosinophil is required to describe the contribution of anemia in severity of air ways inflammation and cardiovascular complications in asthmatic patients [15, 16]. Our study was an effort to fulfill this gape and to provide the knowledge about the variation in lipid profile, IgE and neutrophil levels in the anemic patients having asthma with respect to nonanemic asthmatic patients.

2. MATERIALS AND METHODS

Cross sectional comparative study was carried out at Pathology lab of Asia Diagnostic center Blue area Islamabad. From October 2018 to Jan 2019 total 100 asthmatic females and 100 normal control females of same age group were enrolled in this study after getting their informed consents. EDTA and Clotted samples were collected by using the sops of Phlebotomy. EDTA samples were saved at 2-8°C and after centrifugation of clotted samples, Serum were saved at -20°C. Hb levels and Total leukocyte count was performed by hematology analyzer Abacus 380 and eosinophil count was performed by manual counting on glass slide after stain the blood smear with giemsa stain and % of eosinophil was converted in to absolute eosinophil count by the formula % eosinophil* total leukocyte count *103/ul. TG, Total Cholesterol, HDL were measured on semiautomatic Chemistry analyzer Micro Lab 300 by using the Reagents of Merck. VLDL was calculated by TG/5 and LDL-C ware calculated by Fried Ewald equation. Serum IgE levels were performed by ELISA method.

2.1 Inclusion Criteria

Asthmatic Females were selected as cases and Non asthmatic females were selected as control.

2.2 Exclusion Criteria

Females with the history of parasitic infections, Diabetes and metabolic syndrome, and pregnant females were also excluded in this study.

3. RESULTS

This study was carried out among 100 asthmatic females and 100 normal control females of same age group. The frequency of different age group of cases and control is given in the Table 1. Asthmatic group was further divided in to two groups, Anemic asthmatic females (Group 1a) and Non Anemic asthmatic females (Group 1b). Among the 100 asthmatic females that were enrolled in our study, there were 42 females were anemic having their Hb level less than 12 g/dl. Table 2 shows the frequency of anemia in different age groups and percentage of anemic and non-anemic asthmatic females enrolled in this study. The comparison of lipid profile, IgE and absolute eosinophil count was performed between total asthmatic females (n=100 Asthmatic females Group 1) and control group (n=100 Group 2) females, and P-Value was calculated by twotailed T-test with 95% confidential interval and p-value <0.05 was considered clinically significant. Table 3 describes the comparison of lipid profile, IgE and absolute eosinophil between asthmatic and non-asthmatic females. All the parameters of lipid

profile have p-value less than 0.05, which indicate that there are significant variations in triglyceride, Total Cholesterol, HDL, LDL and VLDL in Asthmatic females (Group 1) and Control (Group 2). Asthmatic females were divided in two groups anemic asthmatic females n=42 (Group 1a) and non-anemic asthmatic (n=58) (Group 1b) as shown in Table 2 and comparison of lipid profile, IgE and Absolute eosinophil count were performed by using two Tailed t-test with 95% confidential interval and P-Value <0.05 was used as clinically significant. Table 4 shows the comparison of Lipid profile, IgE and eosinophil count between Group 1a and Group 1b. There was no difference observed in triglyceride concentration between both Groups as the p vale is greater than 0.05 for TG, but the other parameters of lipid profile were significantly high in Anemic (42) Group 1a. IgE and absolute eosinophil count were also significantly high in Group 1a than the Group 1b. Pearson correlation coefficient was also performed to investigate the relationship between Hb levels and variation in lipid profile, IgE and absolute Eosinophil count. Shown in Table 5. Hb levels were negatively associated with triglyceride. Total Cholesterol, LDL, VLDL, IgE and eosinophil count and positively correlated with HDL in

Table 1. Frequency distribution of different age groups of Asthmatic females (Group 1) and Control (Group 2)

Age groups	19-29	30-39	40-49	>50	Total
Control (Group 2)	27	26	29	18	100
Asthmatic females (Group 1)	28	25	30	17	100

 Table 2. Frequency distribution table of Anemic asthmatic females (Group 1a) and Non Anemic asthmatic females (Group 1b)

Group	19-29	30-39	40-49	>50	Total	percentage
Non Anemic asthmatic females (Group 1b)	16	15	17	10	58	58%
Anemic asthmatic females (Group 1a)	12	10	13	7	42	42%

anemic asthmatic females patients. Strong negative correlation was observed in the concentration of IgE and absolute eosinophil count with Hb.

4. DISCUSSION

In the present study 100 asthmatic females and 100 normal controls were enrolled. In asthmatic females there were 42 anemic and 58 were non anemic females. The prevalence of anemia in asthmatic females were 42%, Table 2 without the consideration of urban and rural distribution and that is higher than the prevalence of anemia in general population that is 26% in urban areas and 47 % in rural areas [17]. In bronchial asthma there is pulmonary hypoxia which may contribute in increase of Hb in asthmatic patients [18] but in our study there is high prevalence of anemia in asthmatic patients which indicates that anemic population has higher risk to develop asthma that is why females are at higher rate to have asthma than the males. High Incidents of asthma were reported in child bearing age of females as they have lower Hb than other age groups of females [19]. Another study [20] describes that females having low iron store were higher incidence of asthma and severity of inflammation that supports our findings. Asthma has association with hypocholesteremia and it has been reported that high LDL level in asthma contributes the airways obstruction by inducing inflammation and HDL has negative correlation with the severity of inflammation in asthma. Triglyceride has also positive association with severity of inflammation and airway blockage in bronchial asthma [21]. A positive correlation was observed between dyslipidemia and asthma in large scale study of adolescents. Triglyceride, Total Cholesterol, LDL-C and Low HDL level were associated in high prevalence of asthma [22]. Similar associations were observed in our study Table 3. All the components of lipid profile TG, Total Cholesterol, LDL-C,HDL-C and VLDL-C were significantly different than the controls having P-Value <0.05.HDL-C levels were markedly low in asthmatic females with elevated TG, Total Cholesterol, LDL-C and VLDL-C. Serum IgE and absolute Eosinophil count were markedly high than the controls. The association of lipid profile with anemia is different

Test	Asthmatic females (Group 1)	Control (Group 2)	P- value
Triglyceride	138.2+_23.4	130.4+_22.5	0.0172
Total Cholesterol	164.2+_22.1	157.6+_23.5	0.0377
HDL	38.8+_5.4	40.3+_5.1	0.0448
LDL	100.2+_29.5	92.5+_24.3	0.0453
VLDL	26.6+_5.8	25.8+_5.4	0.3140
IgE	2032+_590	345.8+_170.8	< 0.0001
Eosinophil Count	0.27*103/ul	0.05*103/ul	< 0.0001

Table 3. Comparison of Lipid profile in Asthmatic females (Group 1) and Control (Group 2) by using s-t-test.

Table 4. Comparison of Lipid profile, IgE AND eosinophil count between Group 1a and Group 1b.

Test	Anemic (42) Group 1a	Non anemic (58) and Group 1b	P-value
Trig	139.8+_27.9	137.0+_25.5	0.6036
T.Chol	171.5+_20.7	159.0+_25.3	0.0100
HDL	36.7+_4.9	39.6+_5.9	0.0107
LDL	104.3+_30.9	97.2+_28.6	0.2391
VLDL	26.3+_6	25.9+_5.8	0.7380
IgE	2241+_672	1987+_480	0.0297
Eosinophil	0.32+_0.08*103/ul	0.25+_0.06*103/ul	< 0.0001

Table 5. Pearson correlation coefficient of test

 parameters with HB in Anemic Asthmatic patients

Test	Correlation coefficient
Trig	-0.26
T.Chol	-0.41
HDL	0.33
LDL	-0.60
VLDL	-0.36
IgE	-0.61
Eosinophil	-0.99

in different studies. Some studies support the statement that in anemia, there is low level of TG, Cholesterol and LDL-C [23]. In present study there was high concentration of lipid profile parameters in Asthmatic Group1 than non-asthmatic Group 2. When we compared the values of lipid parameters between the anemic and non-anemic asthmatic Groups, there were considerable differences in levels of Total Cholesterol, LDL-C, HDL-C and VLD-C between both Groups. High levels of LDL and Low levels of HDL were associated with anemia in asthmatic patients (Table 4). Pearson

correlation coefficient was used to determine the relationship between Hb levels in anemic asthmatic females and Lipid parameters. Here we observed a negative correlation among all the parameters of lipid profile except HDL which was positively associated with Hb levels and strong negative correlation was observed for Total cholesterol and LDL-C (Table 5). This association of dyslipidemia with anemia in asthmatic patients can be described when we look upon the association of asthma with lipids and anemia separately. Prevalence of asthma is at higher rate in iron deficient anemic females [7] and dyslipidemia is also positively associated with asthma [9]. When anemia is positively associated with asthma and dyslipidemia is also positively associated with asthma then in anemic asthmatic females with high levels of lipids as in the results of our study have possibilities to have high severity of inflammation in anemic asthmatic females. Serum IgE and Eosinophil count were also high in anemic asthmatic females than non-anemic asthmatic female with p-value < 0.05. Serum IgE and Eosinophil count showed strong negative correlation with Hb levels in anemicasthmatic females, shown in (Table 5). Iron deficiency is correlated with High eosinophil count [24] and

IgE levels were also associated with iron status and Hb levels in asthmatic patients [25]. Main cause of anemia in females is iron deficiency and iron deficiency induces eosinophilia and elevated IgE levels in anemic asthmatic females.

5. CONCLUSIONS

From our study it was concluded that when anemia is present in asthmatic females, it exaggerates systemic inflammatory markers by inducing dyslipidemia, high eosinophil count and high level of IgE, suggesting possibility of worsening of asthma severity due to anemia.

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Research Article

Investigating a Conservation Area Based on Tsunami Hazard Mapping in Landuse Planning of Sand Dune Parangtritis Area, Yogyakarta, Indonesia

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Abstract: The Southern part of Java Island is highly risked from natural disaster, particulary tsunami. In this research, we investigated a conservation area of the southern part of Yogyakarta (Bantul Regency), Indonesia, namely Parangtritis. Sand dune in Parangtritis is a natural barrier for tsunami threat. Material loss caused by tsunami can be reduced by identifying natural barrier of sand dune through tsunami hazard zones. We propose a method to investigate changes of sand dune condition by simulating the tsunami inundation hazard impact and implementing a remote sensing application. A water depth of tsunami model scenario was used to estimate the tsunami inundation zone. The tsunami modeling used Shuttle Radar Topography Mission (SRTM) data to build Digital Elevation Model (DEM) data. Topographical map and ALOS imagery were used to analyze land coverage. Based on our simulation, the tsunami tends to surge toward the southeast direction with 30 m of elevation. Material loss due to tsunami is catastrophic; hence more extensive sand dune conservation area is required. This research provides a tsunami hazard map and a sand dune conservation map based on our simulation. In future, our research might be used as a guideline for development of policy to develop and to protect sand dune conservation area.

Keywords: Coastal area, Disaster mitigation, Land use, Tsunami hazards map.

1. INTRODUCTION

Indonesia is one of the most vulnerable areas from natural disaster because it is located nearby the zone where three main tectonic plates collide. Java Island is highly risked by a tsunami disaster due to its tectonic setting. The catalog for tsunamis in the Indian Ocean recorded that the movement of Sunda arc area generated 80 % of the tsunamis with various scale of movements [1]. This island is located in the outer arc of the volcanic belt, which is the same situation with Aceh. In the year of 2006, tsunami hazard occurred in coastal area of West Java, which then removed across the coastal of Java island to the east of Java in southern coastal part. The tsunami affected all coastal part of the southern Java island area. In this case, the tsunami may be caused by subduction zone of Indian Plate and Eurasian Plate in the sea of the southern part of Yogyakarta, Indonesia [2].

The risk of great disasters is originated from various earthquakes in the coastal part of West Java [4]. On December 22, 2018, the western coastal area of Java was hit by a tsunami. The tsunami caused massive damages in Banten province. The disaster was generated by a volcanic eruption of Krakatau volcano [5]. The tsunami killed more than 426 people with 14,059 people were reported injured and 24 people were missing. The disaster caused

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damages to settlement, public facilities, rural and farm areas.

Although tsunami is infrequent disaster, it has been recorded as a catastrophic disaster that causes a big number of victims and wide hazard impact zone. The largest tsunami disaster was generated by Krakatau Volcano eruption in 1883. The tsunami had 38 m of maximum surges height penetrating 2.5 km in Sumatra and Java. A strong earthquake caused another big tsunami in 2004. It was registered as an enormous earthquake in Indonesia since 1990. The hazard created 30 m surges of tsunami penetrating 4 km inland and destructing all the building the surged passed. Table 1 represents the tsunamis record in Indonesia.

On the other hand, the coastal area in Indonesia can be categorized into short term, medium term and long term area [3]. The classification is based on different kinds of natural hazards, land uplift of subsidence, and rise and fall of seal level. The sand dune in the southern part of Yogyakarta, Indonesia is is expressed as the unique sand dune coastal area in the South East region of Asia. The sand deposits here consist of beach sand and sand dune.

Parangtritis beach is located at the southern part of Java coastal and near from the subduction area. The beach straightly faces the plate of Eurasian and Indo-Australian. The beach is sandy gray with a view of hills in the East and North and a view of barchan type sand dune in the western part. These conditions make the area Parangtritis become a very popular tourism spot. Since Parangtritis is mostly a flat area and consists of built up area, Parangtritis is highly vulnerable to the impact of any tsunami. Parangtritis as a research area is described in Fig. 1.

Establishment of spatial range for inundation prediction as well as for calculation of agricultural damage over a large area spatially can be derived through a combination of Geographic Information System and a remote sensing technique [4]. Development and application of satellites images technology are increasing rapidly. Precision farming can be achieved by incorporating satellite data for land-use determination in coastal area. Furthermore, the ALOS satellites are considerable in the accuracy of agriculture land classification mapping.

Implementation of remote sensing technology for disaster mapping of coastal area has progressed swiftly in the recent decade. Spatial information of coastal morphology can be produced by Landsat ETM and DEM data [6–11]. Hill shade, slope steepness, range of curvature maps are derived through digital image processing methods based on the SRTM DEM extraction of morphological traces. Tsunami analysis by delineation of coastal regions can be derived by combining earthquake data in a Geographic Information System database, Landsat ETM, and the morphological maps of coastal area. In this research, a conservation management area has been reported based on disaster mitigation

Location	Population of Disaster Impact (people)	Magnitude Scale (Richter)	Periods
Palu	3	8	1996
Biak Island	107	8	1996
Tabuna Maliabu	34	-	1998
Banggai	4	-	2000
Nanggroe Aceh Darussalam and North Sumatera	> 200 000	9.1	2004
Nias Island	-	-	2005
South Java	665	7.7	2006

 Table 1. Tsunami record in Indonesia [1]



Fig. 1. Parangtritis coastal area

of tsunami inundation hazard in Parangtritis, Yogyakarta, Indonesia. This research is important as: (i) the coastal area in the southern part of Java is vulnerable from tsunami and is at risk from future tsunami occurrence [12], (ii) sand dune zones in Parangtritis are scientifically investigated; (iii) the sub district government is accomodating to create the local disaster mitigation plan for disaster risk reduction. Thus, our results will be valuable data to support the governmental programs. Furthermore, coastal land-use planning in general does not consider hazards in the coastal area.

Sand dune in Parangtritis is a natural barrier from the threat of tsunami. Various human activities, such as very intensive river tailing, affect condition of sand dune in Parangtritis. If sand river tailing activities get more intensive, the condition of sand dune exacerbates. Thus, the sand dune condition is not in optimal situation as there is not enough material supply. Furthermore, the presence of settlement area also affects the sand dune development. Many peoples in Parangtritis are not aware of protection of the sand dune area. Furthermore, there is insufficient attention of sub district government to coastal conservation by considering tsunami hazard zones. The declining function of the sand dune increases the risk of this area.

2. MATERIALS AND METHODS

Water depth scenario is used to determine tsunami inundation zone. The sand dune areas are detected based on the inundation zone. This research has not considered the hydrodynamic parameters of tsunami hazard. Furthermore, we ignore source region of tsunami and coastal configuration during inundation. In the identification of inundation zones, bathymetry of seabed is ignored because there was no information about bathymetry of the study area in detailed scale. Obtaining such data is expensive both in funds and in time. Analysis of tsunami inundation was performed under two types of scenario: direction of wave scenario (west, south, southeast and southwest direction) and wave elevation variation scenario (run-up 5 m, 10 m, 15 m, 20 m, 25 m, and 30 m). In this research, we used Geographic Information System to calculate elevation in the plain. Next, we developed an interpolation with Kriging method. The correlation of tsunami wave elevation, surface roughness coefficient, and length of land were then calculated using the following equations [13]:

$$X_{\max} = \frac{0.06H_0^{4/3}}{n^2}$$
(1)

Where:

 X_{max} : Maximum ranges the tsunami on land from the shoreline;

H₀ : Surge vertical measurement;

n : Coefficient of roughness

Equation 2 is used to calculate the loss per 1 meter of surge height. Equation 3 is used to obtain the loss of the altitude of 1 m run-ins [14].

$$\frac{dH}{dX} = \frac{12Sn^2}{H_0^{2/3}}$$
(2)

To trace the surface condition with various height, Equation 2 was converted by arriving a deciding parameter to the loss of the altitude of declination of tsunami wave is expressed by Berryman [11].

$$H_{loss} = \left(\frac{16.7n^2}{H_0^{1/3}}\right) + 0.5\sin S \tag{3}$$

Where:

H_{loss} : Losing tsunami altitude n : Coefficient of roughness

H₀ : Surge vertical measurement

S[°] : Slope Surface

The tsunami velocity in surface area can be expressed using equation as follow:

$$u = \sqrt{2gh} \tag{4}$$

u : Surge speed

g : Gravitation acceleration

h : Inundation deepness

The elevation of tsunami wave is proportional to surge speed (Equation 4). A model with various scenarios describes tsunami hazard: 5 m to 30 m of height with direction scenarios of the surges. These variations represent modeling that possibly happens on the southern part of Java island. Former field evaluation registered that the deliberated runup elevation arranged from 1 m to 16 m around the southern part of Java coastal area in Baron and Batu karas. Since the run-up height wave scenarios is an independent factor, the additional component to solve that equation is surface roughness from the classification of landuse type. The coefficient of roughness is described in Fig. 2. Tsunami scenario model was validated using regression calculation. This method defined a model based on a set of tsunami data. Inundation area from this scenario had a linear relationship. Linear regression attempted to explain this relationship with a straight line fit to the data.

The process from DEM may produce a slope map. The slope was obtained using the topographic map from the Indonesian Geospatial Information Agency (BIG). Ilwis 3.3 software is used in raster operation. The method was correlated by mapping of sand dune conservation region with land-use regulation in Parangtritis sub district. The decision of the assessment on sand dune conservation is proposed to maximize the sand dune utility as a disaster bound. Fig. 3 shows the flowchart research design.

3. RESULTS AND DISCUSSION

3.1 Tsunami Inundation Hazard Scenario Simulation Map

Simulation of tsunami hazard mapping is conducted by supposing the multiplication of tsunami wave pixel in several considering factors, such as coefficient of surface roughness, slope, surge direction, and surge elevation scenarios. The modeling of tsunami inundation is produced depend on the coefficient of surface roughness aspects, the slope condition and inundation distance of surge per



Fig. 2. Land-use roughness coefficient map



Fig. 3. Flowchart research design

meter in research area. These parameters are then used to calculate the inundation to land. The surface roughness coefficient is derived through landuse delineation. The importance of this coefficient is it would be influenced when an inundation was made in the simulation. Although this approach is considered as a simple method, the proposed method will be compelling for disaster mitigation decision maker. Fig. 4 shows diagram of roughness coefficient in Parangtritis. The tsunami prediction modeling, sand dune current condition, and various civilized activities surrounding research area can be used to determine sand dune conservation area. The study may be used to plan appropriate conservation model based on physical and social condition. Quantitative analysis may be supported by interview or focus group discussion involving all stakeholders. Comprehensive assessment of sand dune assessment can be created due to the observed inundation



Fig. 4. Diagram of roughness coefficient [Source: Data calculation 2016]

prediction zone and the quantitative data analysis.

Entrance of tsunami surge in the stationary area of influence can be observed from tsunami inundation simulation. With the height of the surge was set to 30 m, inundation of the largest area occurred when the surge came from the south west of coast resulting 419.14 ha of inundation area. Smallest inundation area occurred if the surges came from the southeast. The tsunami surge scenario with 30 m of height would inundate wider agricultural area. If the surge came from the southern direction, an area of 3.03 ha of paddy fields was inundated. When the surge came from the south west, the inundation area was about 18.21 ha. If the tsunami model was set to 5 m of height, the whole model showed that there were no flooded fields. Tsunami inundation simulation areas are based on surface roughness coefficient, surge direction, surge height variation, and slope (slope) area of research. The parameters are then used to calculate the landward inundation.

Various approaches were done to produce tsunami inundation maps such as developing a scenario due to relief or curve, developing a model based on arithmetical method and roughness coefficient. In our case, as we were constrained by availability of the data, the developed inundation maps were based on tsunami that occurred in southern Java during 2006. Measurement was performed by investigating record of accomplishment of incident in the field and by observing residues on the ground, such as trees, house walls, etc.

The estimation method in this study considered several factors that affected the accuracy of estimation, such as: (i) the number of samples and quality at each data point, (ii) position in the deposit samples, (iii) uniform sampling that yielded better coverage than the sample of cluster model, (iv) The distance between the samples with a point or block to be estimated, and (v) Spatial continuity of the variables involved in tsunami scenarios. Fig. 5 presents inundation maps with various spatial distribution of height and direction of tsunami surge.

Analysis of sand dune coastal area is asserting, the coverage of soil, agriculture and usage by human on the study areas varies in spatio-temporal context. Furthermore, topography of the landscape changes over several years. Hence, measuring these dynamic features is important to gain deeper insight



Fig. 5. Tsunami inundations wave scenarios

of the study areas. Given information that the average vertical height of sand dunes is 10 m, the field study of DRMs data established from 1: 25.000, it is not appropriate to be used in this study. Photogrammetric methods for aerial photographs can be used to develop detailed Digital Elevation Model (DEMs). We used DEMs of detailed contours with 0.5 m of vertical spacing. Triangulation was used to convert contours data into DEMs.

Estimation of cos (i) conducted to the more than three image period was based on a Digital Elevation Model with comparable sand dune parameters. The proposed method is also useful for estimating the sand dune morphology. However, some undesirable affixed parameter in images known as morphology effect may become apparent by the usage of the proposed method. High-resolution DEMs were used for analysis of sand dune. Estimation of coastal dune properties was conducted, such as average sand orientation, distribution and elevation. The samples of DEMs were also adapted to measure shadowing particular dune zone. We chose specific Digital Elevation Model based on type of the dune. The DEM was then moved to find the best match



Fig. 6. Sand dune elevation map



Fig. 7. Sand dune elevation zone [source: Measurement [A1] data calculation, (2016)]



Fig. 8. 3-Dimensional of sand dune

with distribution and direction. Our approach aimed to support visual estimation. Furthermore, the proposed method is useful for study of aeolian geomorphology, by analyzing dynamic aspects of sand dunes topography in spatio-temporal context. Sand dune elevation of the study area is described in Fig. 6 and Fig. 7. Fig. 8 shows 3-Dimensional visualization of sand dune in the study area.

Kriging interpolation was used in this study. Although this interpolation was computationally demanding, this approach was appropriate for passing data to a uniform image grid. The proposed method allowed estimation of variance for each interpolated sample. The variance counted using interpolation between object coordinate and sample. Furthermore, the approximated error deviation of object area also affected the variance. Hence, this approach provided possibilities of more accurate combination. We found that region damaged by ascending mode of ALOS PALSAR image satellite produced large variation. Since only a few data were used in analysis, the rate of distance was high. Moreover, geometrical decorrelation affected the quality of the data.

Fig. 6 showed DEM of Parangtritis area. In coastal zones, the final DEM presented the estimated topography, which is the opposite of acquisition geometry (descending). On the other hand, Fig. 6 also shows that the sample of distribution was fine. Sand dune visualization using 3D image processing was adopted to estimate the wonted covering of the study area.

Fig. 9 shows that the regression equation could be interpreted correlation coefficient (R) are approaching 1 (0.999 6) that means between area inundate and inundate zone have strong correlation or the proportion from this variation inundated area in study area can be related linear with runup elevation in shoreline. Fig. 10 shows tsunami



Fig. 9. Regression of comparing area and inundated zone



Fig. 10. Tsunami Hazard Area of Sand Dune Detection Zone [source: Data calculation [A1], (2016)



Fig. 11a. Tsunami hazard map of sand dune elevation area map with south direction surge simulation



Fig. 11b. Tsunami hazard map of sand dune elevation area map with southwest direction surge simulation



Fig. 11c. Tsunami hazard map of sand dune elevation area map with west direction surge simulation



Fig. 11d. Tsunami hazard map of sand dune elevation area map with southeast direction surge simulation

inundation area of sand dune elevation zone. Fig. 11 shows tsunami hazard map of sand dune elevation area. The big impact of tsunami inundation showed in southwest direction scenario.

3.2 Sand Dunes Conservation Zone

Regent's Decree No. 4/2002 of Bantul Regency is used as a basis for spatial planning in Bantul Regency, Yogyakarta, Indonesia. To support development activities in the coastal area, the local government created meso land-use plan in Parangtritis coastal area. A 100 m to 200 m of buffer zone from the highest water line has been established to deal with land utilization in the coastal area. Moreover, the local government also has designed secure area of around 300 m from the coastal line, which was based on tsunami and high wave events. The macro plan of land-use in Parangtritis area has been divided into eight zones to develop medium to long term risk management plans (as shown in Fig. 12).

3.3 Disaster Mitigation Due to Tsunami Scenarios

The direction and the height of the tsunami surge, and the roughness and the slope of the area affect the distribution of inundation. For instance, an inundation area with 20 m tsunami height has 129.25 ha of area (west surge entrance); 337.96 ha of area (southwest surge entrance); 319.13 ha of



Fig. 12. Land-use plan map

area (south surge entrance); and 197.97 ha (south east surge entrance). To deal with these inundation areas, local government of Bantul Regency has established several early warning systems in coastal areas, in which probability of tsunami occurrence is high. Those completed systems consist of six public addresses, one receiver, one tower, and one amplifier. All of them are connected with a repeater. The repeater is installed in a higher place while actively distributing information to Bantul Regency government. Another advantage of these systems is their ability to inform types of earthquake that can trigger a tsunami. To prevent bigger impact of tsunami hazard, the Bantul regency management have formulated several safety points in hazard area.

4. CONCLUSIONS

Although tsunami is the worst disaster in coastal area, in Indonesia, especially people who live around coastal area were not much known about the big impacts. When tsunami occurs on Aceh 2004, it opened eyes of many people to the destructive tsunami effects. Even though tsunami disaster is catastrophic event that cannot be anticipated; the actuality does not indicate that coastal areas have to closed from human activities.

The negative impact of natural disasters should be minimized by finding the best mitigation effort based on scientific research. Both government and local people have to sit together, discussing standard operational procedure during tsunami occurrence. In this research, preliminary assessment of tsunami vulnerability was undertaken in the Java coastal area to guide mitigation policy and development of disaster management system. Some alternatives land-use options applicable in research area are fish trading market area and Parangtritis mangrove conservation area to accommodate future needs of urban and agricultural development. Our study can also be used to support decision making by various stakeholders.

Additionally, various stakeholders tasked with coastal zone authority to consult targeting coastal assets on Parangtritis coastal area. Finally, we recommend more detailed research that considers the occurrence of tsunami, run up model, coastal characteristics. hydrodynamic, and detailed morphology. Sand dune conservation management requires coordination between stakeholder and local community. Many local communities are aware of the importance of the coastal sand dunes and have their traditional methods of dune conservation and restoration, as in the case of Southern part of Parangtritis Village. It is necessary to revive these traditional practices as they are locally tested and successful strategies. These methods should be supplemented with advanced scientific research and ecological studies to advices agricultural technique of Parangtritis coastal area.

5. ACKNOWLEGEMENTS

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Research Article

Incidence of Dengue in the Highland District Swat, Pakistan: A Major Shift in the Geographical Prevalence of the Disease

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Abstract: Dengue disease has been known as a major public health problem in recent years throughout the world including Pakistan. During 2013 out-break in Pakistan it has shown wider spread to areas which were never endemic to it: more importantly spreading in higher latitude and altitude. To understand its expansion, particularly in the northern mountainous belt we conducted a study in Swat District of Pakistan. Aim of this study was to investigate the factors of this unexpected spread and epidemiology of dengue disease in newly hit area, District Swat. A sample of 180 households was selected for questionnaire survey from the hospital patients' records. Among total population of the selected households around quarter of people endured from disease during last spell. Male were the highest victims particularly between ages of 16-45 years, as they were the most mobile people carrying the virus from other urban centers of Pakistan such as Karachi, Lahore and Peshawar. The result further specified that increased movement into the district from historically endemic region was the igniting factor.

Keywords: Northern Mountains of Pakistan, Swat, Dengue expansion, Epidemiology, Mobility.

1. INTRODUCTION

Historically epidemics of infectious diseases resulted in calamities and have caused large scale mortality of human being in many parts of the world. However, with the advancement of science and technology in health care and medicines during nineteenth century, we were hopeful that infectious diseases will be eradicated soon [1, 2]. Unfortunately, we met with serious challenges of emergence and reemergence of infectious diseases both old and new and some of these diseases are still a major cause of mortality around the World [3, 4]. Dengue is one among the dangerous emerging and fast growing infectious diseases of tropics [5-9]. Various estimates have been reported regarding dengue infections at world level but most widely stated and currently used figure of 50-100 million infections per year is used by WHO [10]. It is now endemic in more than 110 countries, particularly in Asia, the Pacific regions, the Americas, Africa and the Caribbean [11]. This arboviral disease grow faster in urban population in

tropical and sub-tropical regions [12, 13], imposing a heavy toll on economy and health [14, 15].

In developing world, the trend of re-emergence of infectious diseases in epidemic form has been accelerated by changes in environmental conditions particularly climatic elements, socioeconomic conditions, and demographic factors [16-18]. The virus of dengue transmission is climate sensitive for several reasons, i.e. temperature affects the vector born disease through vectors reproductive It can also shift a vector's geographical rate. range or distribution, changing vector-pathogenhost interaction and affecting host susceptibility [19]. The rainfall has a direct relation with density of adult female mosquitoes and availability of breeding sites. An increase in the number of adult female mosquitoes increases the spread of the disease [20]. Lastly the seasonal outline for dengue outbreaks is also important. Areas on both sides of equator particularly in regions, where Asiatic monsoon weather is dominant, and incidence of dengue fluctuates with the rainy period [21, 22].

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Besides the climatic factors, cultural and socioeconomic factors also play an important role in the prevalence of the dengue disease. The close proximity and poor construction of houses and buildings in the cities, use of natural ventilation instead of air conditioning, low access to health services and health education interrelate to support dengue diffusion [23]. Most dengue endemic countries have poor surveillance for dengue, this is especially true in those countries where clinical management of the disease is not up to standard, and where there is lack of accurate data about dengue patients [16, 24].

First dengue case in Pakistan was registered in 1984-85 [25, 26]. Afterwards different outbreaks have been reported from various parts of the country [26, 27]. The first major outbreak was reported in Karachi in 1994-95 [24, 28] the southernmost, coastal city of the country. In 2003 episode cases were reported from other parts of the country including Haripur district of Khyber Pakhtunkhwa (KP). During 2005 to 2006, there was an unexpected spread of this virus in the country [29]. In 2006, over a period of about six months, it affected more than four thousand people and 50 deaths were reported only from Karachi [30]. Since then it became a regular phenomenon with variations in frequency and concentration in various areas of Pakistan. In 2011, the outbreak hit the Punjab province with

a total of 21597 cases of DF and 365 death tolls, making it the world's largest epidemic of DF [31]. During that year it also entered into many districts of the KP, the Northern Province, with total suspected cases of 907. This was for the first time when sporadic dengue cases were reported from the mountainous belt of northern Pakistan.

In 2013, KP was hard hit by dengue epidemic for the first time and around 94% cases of total cases from KP were reported from one of the northern mountainous district of the province – Swat – where previously this disease was almost unknown (Fig. 1). The main objective of this research is to investigate the factors of sudden outbreak and high concentration of dengue in geographically remote locality.

2. MATERIALS AND METHODS

2.1 Study Area

Swat, one of the northern districts of North-west Pakistan, falls in the Hindukush mountain system, and roughly follows the boundary of Swat valley. It covers more than 5 thousands km^2 area [32] stretching between 34° 34' to 35° 55' North latitude and 72° 10' to 72° 50' East longitude (Fig. 2). It is surrounded by mountains, reaching to around 6000m elevation in the north and in the south to



Fig. 1. District wise dengue cases in Khyber Pakhtunkhwa 2013



Fig. 2. Location and Elevation map of the Study Area.

720 m giving out let to River Swat (Fig. 2). River Swat, a 3–6 km wide and almost 70 km long, originates Ushu and Gabral glaciers in the north and enters into Swat basin, where most thickly populated settlements are located. According to 2017 census, District Swat has a total population of 2,309,570 with 274,620 households [33].

Climatically, Swat district has long winters and short summers. The highest mean temperature 33° C is recorded in the month of June at Saidu shareef, while lowest temperature is recorded in January with mean maximum of 11°C and minimum temperature -2°C. The amount of rainfall is highest in March, followed by April, August, February and July (Fig. 3).

During last decade, Swat has suffered heavy loss of various economic sectors like trade, agriculture and tourism during militancy and military operation (2007-2009) and following the super flood of 2010. Beside heavy economic disruption, large numbers of inhabitants of the district were dislocated by these events. Many of them were forced to live in camps established for Internally Displaced Persons (IDP) in different parts of the province while huge number of inhabitants migrated to other parts of the country including areas endemic to dengue disease. In many cases these migrants were living in very poor conditions and were exposed to a number of risks including this infection. After reinstatement of peace in the area most of the internally displaced persons (IDPs) returned to Swat in 2012 and 2013 and majority of them settled in Mingora and Saidu Sharif.

2.2 Methodology

For the identification of samples and sampling design, basic information was collected from Public Health Office (PHO) Swat (KP) between August-November 2013. That information included the details (name, age, sex and address) of all reported. suspected or serologically confirmed DF/DHF cases in the study area. Based on the addresses of patients a total number of Dengue cases for each Mouza (Revenue Village) were linked with Mouza map (polygon layer) which was shown by Proportional Circles (Fig. 4). With the help of this data, three zones i.e. high, medium and low disease concentrated were identified in Swat district. Saidu Sharif and Mingora were selected from urban areas which fall in high concentration zone with very high rate of incidences. Two villages were selected from medium concentration zone that is Nawe Kaley and Takhtaband. Rest of the district from where even single case was reported was identified as low disease concentration zone. Large numbers of such villages were spread over Swat district in all directions; therefore, four villages Kanjo, Sangota, Charbagh and Manglawar, were selected as sample

villages to understand the spread and diffusion of disease (Fig. 4).

For an in-depth analysis at household level, all the identified cases were geo-referenced, using global positioning system (GPS). Out of total affected houseseholds, 180 households were randomly selected for self-administered questionnaires. Household with disease and patients were identified from hospital record while other variables like their age structure and gender, profession, movement history and other related material were collected through questionnaire. Housing and environmental conditions were also recorded.

Focus Group Discussions, each consisting of 8 to 10 persons, were arranged in community places like markets and educational institutes at least two in each sample site. In these FGDs, history of the disease, probable causes of spread and changing environmental conditions of area were discussed. Besides these issues, discussions were of great help on matters like role of government and non-government organizations in awareness campaigns and provision of health facilities. Future risks of the disease were also highlighted in these discussions and interviews with health officials.

Secondary data were obtained from various official and non-official organizations. Projected data of demographic variables for the year, 2013 were obtained from census office. Information about incidences and characteristics of patients and disease were provided by hospitals and directorate



Fig. 3. Climatic conditions of Swat (1974-1995)



Fig. 4. Concentration zones of dengue disease

of health KP. Regional center Peshawar of Pakistan Meteorological Office, provided data for climatic elements like rainfall, temperature and humidity data.

3. RESULTS

3.1 Age and Sex Composition of Sample Population

Total population in surveyed households; was 2198 persons. Among these 463 cases of dengue patients were reported, indicated that 21% of people in the sample households have suffered from disease during last spell. More than one patient was reported from most of these households (Table 1).

Male were affected relatively in higher numbers particularly at the age of 16-30 year and 31-45year as compared to female. Female patients in all ages make 7% and highest were in the same age group as male. Mean age of the patients is 31 with standard deviation of 11.67.

3.2 Occupation of the Dengue Affected Persons

Data revealed that majority of the affected people were students constituting around 40% of all reported cases. This was followed by employed persons (18%) and daily wagers (17%). Least number of cases was reported by house wives (Fig. 5).

3.3 Housing Characteristics of Sample Households

Data about house profile shows that more than 70% the houses were single storey houses while only 29% of the houses were multistory. House structure in small number (20%) was from local material i.e. stones, mud and wood while rest of the houses were built with concrete. Use of air conditioners was very limited and 90% of households did not have air conditioners. Before this out break people were hardly using mosquitoes net (21%) but afterwards more than 90% of people were using nets. Isolated trees were found in the courtyards but most of the trees were located outside the houses. Many of these trees were planted on field boundaries located at some distance from houses. Livestock keeping was reported by around 40% of households and most of houses (76%) had animal shed inside or attached to the house (Table 2).

3.4 Mobility of People in Dengue Affected Households

Epidemiological questions such as travel history, incubation period, and first day of illness were evaluated to identify the possible origin of dengue infection. According to the field survey most of the patients were mobile. More than 90% of male moved out of their place of origin and around 7% of female had mobility history in that context.

Around 4 % patients, all males were having travel history to Lahore and last trip before two weeks of their illness. These were among those who normally have to visit Lahore at least once a month for business pursuits. Most of them (12 out 20 persons) are involved in used tyer tire business. Further 12% of the patients were recently returned back from different parts of the country and they were among the first registered patients at Saidu Teaching Hospital. Around half of male and 5% female patients were not the bonafide resident of Mingora. Many of them were students and few of them were working in these areas. Forty-seven (47) dengue patients were found having no history of mobility prior to the attack of the disease (Table 3).

4. DISCUSSION

relationship between А complex exists socioeconomic factors like age and sex of patients and occurrences of dengue cases in different environmental settings [34]. Age and sex wise distribution of dengue disease has significant role in epidemiological studies more particularly for identification of population at higher risk. Higher number of cases reported by male in Swat in 2013 episode has shown similar trend as in other areas of Pakistan [25, 29] as well as the world [35]. However, the ratio of male female cases is very high in this study. In some studies slightly more women were affected particularly in Brazil and other countries of Latin America [36]. The probable reasons could be vector's indoor characteristics as well as greater use of health services by women in those areas. In our study the situation is different and reasons could be contrary as women in the area have restricted mobility, higher body coverage and are less visible in seeking health services. This also could be due to involvement of twin vectors Aedes albopictus outdoor prevalence and Aedes aegypti indoor prevalence in this episode [37]. Nadeeka, [38] reported that gender is not a significant variable and younger population (under 18 years) has higher vulnerability.



Fig. 5. Occupation of the dengue affected person
		Age in Years					Std.	
Sex	1-15	16-30	31-45	46-59	60+	— Total	Mean age	Deviation
Male	404 (11)	298 (177)	273 (152)	164 (85)	80 (6)	1219 (431)	31.2	11.67
Female	340 (1)	203 (16)	193 (9)	183(5)	60 (1)	979 (32)		
Both	744	501	466	347	140	2198 (463)		

Table 1. District Swat: Age and sex composition of sample households

Source: Field Survey 2014

Note: Figures in parenthesis show dengue patients

Table 2. District Swat: Housing characteristics of sample households

Housing cha	aracteristics	Frequency	Percentage
Harrage from a	Single storey	129	71
House type	Double storey	051	29
	Kacha	037	20
House structure	Pacca	087	49
	Semi pacca	056	31
Air conditioners	Yes	019	10
All conditioners	No	161	90
Liss of magnitude not	Before this episode	21	12
Use of mosquitoes net	After this episode	164	91
Versteller	Inside house	56	31
vegetation	Outside house	124	69
P' 11	Adjacent to house	52	29
Fields	Away from house	128	71
	Inside house	56	76
Animal shed (74)	Outside house	18	24
····	In court yard	023	13
Water tanks	On rooftop	157	87
	Covered	164	91
Water utensils	Uncovered	016	09
Remove water from flower	Yes	011	06
pots	No	169	94

 Table 3. District Swat: Movement of the sample population

	Purposes of N	Purposes of Movement					
Place of Movement	Business	Daily Wager	Education	Employment	Total		
Lahore	20	0	0	0	20		
Mingora	5	38	86	79	208		
Saidu Sharif	2	30	80	76	188		
Total	27	68	166	155	416		

Dengue in many countries is known as childhood disease like Thailand [39], Colombia [40], Philippines [41] and Mexico [42]. Initially dengue was considered as disease of children but in many countries it has shown higher trend in adult age [43]. The general pattern for age distribution in the present study shows that cases were relatively low in the children as well as aged. Median age of this study (31) is located in the range of age 24-32 shown by number of studies [44]. The higher number of adult males as compared to the female and children and the elderly people is probably due to greater exposure of male to vector during day time at work place or while travelling to and from work, more specifically movement of adult male to endemic areas. As highest number of cases were reported in adult age group, thus the economically active group was affected by disease which could have damaged the already stressed local and household economy of the district. This has also been supported by prevalence of disease in students as the education institutions are located in Mingora and Saidu Sharif, the high concentration zones mobility to these areas has caused the spread. Occupation, age and sex composition clearly indicate that infection has spread through host. Those who were immobile and stayed home like elderly, children and housewives were very few in numbers.

In the study area mixed agriculture is practiced and the presence of vegetable farms, fruit trees and mixed cropland increase the chance of Aedes mosquito development [45, 46]. In higher altitude of Swat, Pines trees, Dewdar, Dedar, Beyar are common, while in plain areas where temperature is relatively high, plants of broad leaves like Bakyan, Poplar and Willow are found. Holes and axils of these trees also provides sites for the growth of Aedes mosquitos larva. About 70% of the households were having plants and fields around the houses. This increases the chances of out door dominence of vector.

Housing factors in the study area were classified on the basis of structure and type. Majority of the houses were Semi pacca (made of wood, stones and concreate material) and single storey. Use of air conditioners and mosquito nets was very limitted. However, after this episode NGOs working in the area have distributed nets in large quantities and as a result of awareness campaigns, use of nets became common. Storage tanks were mosly on roof tops and water utensils were covered. All these factors could have resulted in low risk of indoor vector. The only factor favouring vector inside houses was the presence of water in flower pots.

Water availability in the study area becomes a serious problem in summer; therefore, almost all houses were having water storage tanks. Most of these tanks were placed at roof tops and were properly covered. Water utensils particularly those used for drinking purposes were clean and covered. In small number of houses flower pots were present. However, water from these pots was not regularly removed.

Mobility record of people has confirmed that imported dengue cases have played vital role spread of this disease in Swat resulting in epidemics of 2013. This in line with study conducted by Garcia et al. [47] which stated that human movement have serious impacts on spatial spread of infectious disease and on outbreak dynamics. Although, reasons for current dengue outbreak in Pakistan are multi-factorial [48] but long distance importations like in present study is attributed to the involvement of Aedes aegypti in spread of dengue [49]. Imported dengue cases are defined as laboratory-confirmed dengue cases with travel history to endemic area within 14 days before the date of onset of dengue (based on Taiwan-CDC's definition).

Due to the internal conflict in Swat District, most of the inhabitants were displaced. To accommodate these Internally Dispersed Persons (IDPs), the government had set up camps in Peshawar, Mardan and Swabi districts of Khyber Pakhtunkhwa. Military operation was started against Taliban groups in Swat district in April 2009. The operation was lunched due to law and order situation resulted from the failure of two agreements of the provisional government [50]. All sectors of life were badly affected and majority of the inhabitants lost their livelihood assets. Prior to the conflict. Swat was the hub of tourism and large number of tourists from all over the country used to come to this area. Large numbers of people in Swat were therefore employed in tourism related business. This sector was totally devastated by unrest in the area leaving thousands of locals as jobless. Another

huge chunk of skilled labour force was left without jobs due to the declination of industries. All these people were forced to migrate to other districts of the country. Many of them, IDPs, shifted to larger urban centers like Lahore and Karachi for jobs as well started business over there.

After the reinforcement of law and order situation in 2012 the inhabitants started to move back to Swat. Majority of these families settled in Mingora and Saidu Shareef being the District Head Quarter or established their businesses in Mingora which increased intra district mobility. During 2012 and 2013 tourism industry was also encouraged as festivals and programs were initiated by Pakistan Army to boost the economy as well as moral of the local inhabitants.

5. CONCLUSIONS

Though Dengue virus has caused many epidemics since 1994 till 2011 in Pakistan, almost all of these outbreaks were in relatively low lying plain of southern and central parts of the country. However, in 2013 for the very first time the northern mountainous belt experienced unusual Dengue outbreak. According to available literature dengue endemic belt lies between 35° N to 35° S and the study area lies at the outer margins of latitudinal limits. Nevertheless, the ceiling for this disease has been delimited up to 2000 meters at 19° North latitude for Mexico and 2.200 m for Colombia (4⁰ North latitude). In the present study dengue cases were reported from altitude and that has never been reported in the relevant literature around happened in the world.

This study reveals that mobility of the people has played a significant role in the outbreak and unusual spread of dengue in the remote mountainous area. Economic disruption due to conflicts resulted in dislocation of large number of inhabitants. Many of them were forced to live in camps established for Internally Displaced Persons (IDP) in different parts of the province while huge number of inhabitants migrated to other parts of the country including areas endemic to dengue disease. In many cases these migrants were living in very poor conditions and were exposed to a number of risks including this infection. After reinstatement of peace in the area most of the internally displaced persons (IDPs) returned to Swat in 2012 and 2013 and majority of them settled in Mingora and Saidu Sharif and ignited dengue disease in the area.

The local environmental conditions also favored for the long-term survival of the vector from August through November in this geographically unique milieu. Large scale movement between Swat and endemic cities and within the district for the search of improved socioeconomic conditions and opportunities were accelerated by years of conflict and followed by devastating flood. This population mobility has been identified as an important contributing factor to the explosive nature of the outbreak.

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Research Article

Ratooning Ability & Performance of Hybrid Variety Mestizo7 (NSIC Rc136H), for Yield Characters under Different NPK Levels at Irrigated Low Land Conditions of Rice

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Abstract: Field experiments were used in experimental research sites from Centeral Luzon State University (CLSU), Science city of Munoz Nueva Ecija, Philippines, to value the level of nitrogen in hybrid variety Mestizo7 Hybrid (NSIC Rc136 H) was used as observation matter material. In the characters of performance. Mestizo7 was more spikelets / panicles, full grain and grain production / ha. To determine the ratoon crop as issue of fertilizer, level of hybrid variety Mestizo7 at 120-30-30 kg NPK / ha, 4768 for the longest crop. The 00 kg / ha and 150-30-30 kg / kg NPK / kg 4714 kg/ha, was the production of grain production, 100 percent. Production increased by 33 percent and 99.20% of non-nutrition plants with 2380 kg / ha.

Keywords: Irrigated lowland, NPK levels, Hybrid variety, Ratooning ability.

1. INTRODUCTION

In the economy of agriculture world, rice crop occupies a strong place being the most important diet crop by providing nutrition for people over any other crop. It represents 23% of the world's calorie supply. Rice is grown on an area of over 2.5 million hectares with an average yield of 2,117 kg per hectares. The Pakistan ranks at ninth position with respect to the area and at rank 14th for yield per hectares worldwide. In rice ecosystem of Pakistan, after harvesting of main crop a waste area remains uncultivated/followed [1]. It has been successfully adopted in many counties including India, japan. USA. Philippines. Brazil, Thailand and Taiwan. In India, of the 40 M ha under rice, about 18.9 M ha constitute the ratooning under lowland. It is known as stubble rice in USA, regeneration rice in China, second flowering in rice in London, UK and ratoon rice in India and Bangladesh. If this scenario is creditable that cost reducing technology such as, ratooning will gain relevance as an option

to planting a second rice crop provided farmers are confident that they can realize reasonable ratoon yields. [2] Observed that 120 kg N ha⁻¹ was noticed heavier 1000 grains weight and highest grain and straw yield. In treatment combination of 15 cm Culm cutting height of Culm and 120 kg N⁻¹ were found to produce also the highest grain yield. The highest grain yield (1.56 t/ha⁻¹) resulted from ratoon crop was 25.16% of the primary crop. The yield and most of the other plant attributes were lower and field duration was also shorter in ratoon crop than those of the primary crop. Sosimo (2003) and Xu et al. (2000) investigated the A highly significant negative correlation was found to exit between grain number per panicle and the leaf area for grain filling of the main crop [3, 4]. The more grains set on the panicle, the less photosynthetic matter remain in the basic stems for ratooing rice growth at harvest of the major crop reported that Magilas, a hybrid rice variety developed by Monsanto, produces a higher ratoon yield than PSBRcH, more popularly known as Mestizo7. The highest yield of Magilas

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was 4.3 tons per hectare (t/ha), which was a little over half of the main crop yield. On the other hand, the highest yield Mestizo7 was 2.1 t/ ha. Magilas had the highest ratoon vigor and most uniform stand compared Mestizo7 and two inbred varieties. Combined with the yield of the main crop, Magilas yielded a total of 12.7 t/ha, while that of Mestizo was 10.3 t/ha. The first management choice begins before the main crops even planted with the selection of an early maturing variety with a high ratooning potential. Rice breeding effort sat Rice Research station over the past decade have further improved the potential success of the ratoon crop by releasing six rice varieties that reach 50 percent heading in 81 days or less. In fact, the potential new clear field variety c11 11 reaches 50% heading in approximately 79 days [5].

2. MATERIALS AND METHODS

The experiment was conducted on the ability of ratooning for different cuttings. In the experimental area of the Research Office Centeral Luzon State University (CLSU), hybrid and inbred varieties were applied for different deficiency and fertilizer levels. The main crop experiment was conducted in the wet season. For the main crop, field was prepared thoroughly by plowing and harrowing until the desired soil tilth was attained. Four hundred grams of seed of variety of Mestizo7 (NSICRc136H), was soaked for 24 hours in fungicide solution to minimize the disease infestation in nursery of transplanted rice. Seed was sown in a wellprepared two by two seedbed. The experiment was laid out following three by two Factorial in Randomized Complete Block Design (RCBD) along with three replications using four by five m plots, with 0.5m distance between plots, twenty rows in each plot. The total area under experiment was 017m². There were twenty-five days of healthy transplanted seedlings in the two-year area to three plants/hill for inbred varieties and single plant/hill. following a distance of 20x20 cm between hills. Replanting of miss place hills was done three to five days after transplanting. During transplanting water level was maintained at two to three cm depth until 25-30 DAT, to prevent weed seed germination. Water was made available at the time of fertilizer and granular insecticide application. Two weeks before harvesting, the field was drained granularly to hasten maturity, prevent lodging and harden the

soil for easy harvesting.

The main crop was fertilized at 15, 30 and 45 days and their transplanting, to 150-30-30, kg NPK /ha, the basal rate was 30-30-30 kg NPK/ ha and second application was 30-0-0 kg NPK/ha and third application was 30-0-0 kg NPK/ha. The fertilized applied was complete fertilized (14-14-14) and Urea (46-0-0). The pre emergence herbicide butachlor (Machete) was applied at two to three days after transplanting at the recommended rate of 1.5 to 2.00 kg, a.i./ha. It was sprayed directly on the soil. Also weed were controlled by manual weeding as required to keep the field clean. The experiment was monitored daily for pest and disease incidence. For this purpose, recommended insecticides and fungicides were applied separately to prevent or control attack and appearance of pests. The rate and time of application were based on the severity of pests and diseases. Stalks were cut before the main crop was fully matured, when 80-85% of the grains in the panicle were brown in color. After harvesting in threshing, the threshed grains were sun dried for two to three days, and weighed. The moisture content was determined with a moisture meter. After harvesting the main crop, cutting heights for the ratoon crop was maintained as per plant of factor A. For ratoon crop the experiment was conducted after the harvesting of main crop which was grown from September to November 2010.

The ration crop experiment was comprised of similar layout and design of the main crop along with the following treatment combination:

- ✓ Factor A=Cutting height (cm), as H1=15cmH2=30cm
- ✓ Factor B=Level of fertilizer F1=0-0-0 NPK kg/ ha, F2=120-30-30 NPK kg/ha, F3=150-30-30 NPK kg/ha.

2.1 Data for Main Crop and Ratoon Crop

Agro-climatic conditions, Length of panicle (cm), Number of spikelet per panicle, number of filled grains per panicle, percent panicle spikelet, weight of 1000 grains (g) and grain yield (kg/ha). The data was statistically analyzed using factorial arrangement in RCBD. For significant effects, comparison was done multiple range of Duncan using test (DMRT). The computations were done

using IRRISTAT for window and SAS V. 9.0. The main objective of the study was to determine the performance of hybrid rice variety Mestizo7 (NSIC Rc136H) for rationing at various cutting heights and, fertilizer application.

3. RESULTS AND DISCUSSION

3.1 Agro-climatic Condition During the Study

The agro climatic data was gathered and it is presented in Table 1. The data of rainfall, relative humidity and temperature for the main crop are shown; the lowest temperature was from 20.9 °C and the highest was 34.2 °C, relative humidity was from 82% to 89%, while the rainfall obtained during this experiment was recorded from 6.1 mm to 15.40 mm, respectively. The weather data gathered during the ratoon crop on temperature ranged from 23.80 °C to 32.30 °C, relative humidity ranged from 73.00% to 89.00% and rain fall recorded during the experiment was from 4.00mm to 9.60 mm. respectively. [1, 4, 5] reported that a long crop can be achieved if two or three nodes of the main crop remain, and the flow of times, temperature, day length and other factors affect the depth. Its effect on the duration of the main crop and rice ratooning is also different.

On fertilizer levels, the highest rate of fertilizer (150-30-30 kg NPK/ha) produced greater number

of spikelet's with 88.00. Mestizo7 ratooned at the height of 15 and 30cm 150-30-30 kg grams applied with NPK and Mestizo7 ratooned at 30cm applied with 120-30-30 kg NPK/ha produced more number of spikelets per panicle and they were comparable but better than other treatment combinations.

3.2 Number of Filled Spikelet/panicle

There is a significant difference between the average numbers of filled spikelets of Mestizo7 influenced by fertilizer level. It was observed that the highest rate (150-30-30 kg NPK/ha) obtained the highest number of filled spikelets as compared to 120-30-30 kg NPK/ha and the unfertilized plants. In addition, the unfertilized plants significantly exhibited least number of filled spikelets/panicle (Table 4). The interaction of fertilizer level and cutting height resulted in comparable number of filled spikelets/panicle. [6] Found that cutting height has a significant effect on filled spikelets/panicle. Similar findings were reported by previous study [4,7,3] that N application increased the filled spikelets.

3.3 Percent of Filled Spikelet/Panicle

The effect of cutting heights, fertilizer levels and treatment interaction on the percent of filled spikelet/panicle for Mestizo7 is shown on Table 5. The percent filled spikelets were not influenced by

Table 1. Agro-climatic data on the experimental period from June to November -2010 taken at the weather Statio
located inside the CLSU campus Science City of Munoz Nueva Ecija, Philippines

Main Crop	Relative Humidity%	Temperature ⁰ C	Rain fall (mm)	Periods
Max.	Min	8		1996
June	34.20	20.90	6.10	89.00
July	33.00	24.50	15.40	81.00
August	31.80	24.30	9.90	85.00
September	32.10	23.80	7.80	82.00

Table 2. Average panel length (cm), according to cutting height and NPK fertilizer levels in hybrid and inbred pure varieties

Cutting heights (cm)	0-0-0	Fertilizer level (kg NPK/ha) 120-30-30	150-30-30	Mean
15	19.5	20.85	21.33	20.56
30	19.14	21.33	21.03	20.50
Mean	19.32 Y	21.09 x	21.18x	

Cutting Heights	0-0-0 (kg NPK/ha)	120-30-30 (kg NPK/ha)	150-30-30 (kg NPK/ha)	Mean
15 cm	19.50	20.85	21.33	20.56
30cm	19.14	21.3	321.03	20.50
Mean	19.32 Y	21.09 x	21.18x	

 Table 3. Average panel length (cm), according to cutting height and NPK fertilizer levels in hybrid & inbred pure varieties

Note: Means not sharing letter in common differ significantly by Ducan's Multiple Range Test

Table 4. Average panel length (cm), according to cutting height and NPK fertilizer levels in hybrid and inbred pure varieties

Cutting heights (cm)	0-0-0	Fertilizer level (kg NPK/ha) 120-30-30	150-30-30	Mean
15 cm	44.00	70.00	79.00	64.00
30	49.00	80.00	76.00	68.00
Mean	46.00 z	7 5.00 y	77.00 x	

Means not sharing letter in common differ significantly by Ducan's Multiple Range Test.

the all treatments. While, the results of the current study disagreed with the previous results of [8, 9, 11, 10, 12] who observed that cutting height had a significant effect on percentage of filled grains.

treatment interaction. Hybrid Mestizo7 with fertilizer (150-30-30 and 120-30-30 kg/ha) produced heavier grain/1000 as compared to un fertilized plants.

3.4 Weight of 1000 Grain (g)

As shown in Table 6 there is significant difference between the 1000 grain weight influenced with the fertilizer levels but not on cutting height and

3.5 Grain Yield kg/ha

The influence of cutting heights and fertilizer level on the grain yield/ha was found significant (Table 7). For Mestizo7, the yield increased with

 Table 5. Average percent of filled as affected bycutting heights and NPK fertilizer levels in hybrid and inbred varieties

Cutting heights (cm)	0-0-0	Fertilizer level (kg NPK/ha) 120-30-30	150-30-30	Mean
15 cm	83.00	90.00	89.00	87.00
30	88.00	91.00	87.00	89.00
Mean	86.00	91.00		

Note: Means not sharing letter in common differ significantly by Ducan's Multiple Range Test

 Table 6. Average weight of 1000 grain (gm) as affected by cutting heights and NPK fertilizer levels in hybrid and inbred varieties

Cutting heights (cm)	0-0-0	Fertilizer level (kg NPK/ha) 120-30-30	150-30-30	Mean
15 cm	32.00	36.00	35.00	34.00
30	32.00	38.00	38.00	36.00
Mean	32.00 ч	37.00x	36.45x	

Note: Means not sharing letter in common differ significantly by Ducan's Multiple Range Test

Cutting		Fertilizer level (kg NPK/h	a)	Mean
heights (cm)	0-0-0	120-30-30	150-30-30	
15 cm	2244.00	4505.00	4410.00	3718.00
30	2519.00	5031.00	5072.00	4207.00
Mean	2380.00 ч	4768.00x	4741.00x	

Table 7. Average Yield kg/ha as affected by cutting heights and NPK fertilizer levels

Note: Means not sharing letter in common differ significantly by Ducan's Multiple Range Test

13.5%. Crop that were cut at the height of 30cm yielded 4207 kg/ha 3718 kg/ha for plants cut at the height of 30cm and 15cm, which is increased by 99.20% (4741kg /ha) to 100.33%(4768.00kg/ha) when applied with fertilizer at the rate of 150-30-30 and 120-30-30kg NPK/ha, respectively, and these were significantly higher compared to unfertilized plants (2380kg/ha). The yield increase for fertilized plants in Mestizo7 was comparable.

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Research Article

Surveillance and Documentation of Fruit Flies Parasitoids from Infested Fruits Collected from District Larkana and Hyderabad

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Abstract: Fruit flies belong to family (Tephritidae-Diptera) are the most injurious fruit pests of the fruits and vegetables. Biological control is an environmental friendly control method that has been used against pest fruit flies. Parasitoids have been one of the most widely used groups of natural enemies. In present studies we have surveyed the biological control agents from two different zones of Sindh. The field locations were Hyderabad and Larkana districts from where infested fruits were collected from guava and mango orchards. The results revealed that significantly (P<0.05) higher number of larval cum pupal parasitoid *Trybliographa daci* were (62.2 ± 3.03 , 50.20 ± 4.45) recorded in guava from both districts. Furthermore, Maximum number of *Bactrocera zonata* infestation was recorded (395.6 ± 4.50 , 288.00 ± 11.57) from guava orchards of both districts. This study established that Larval/pupal parasitoid *Trybliographa daci* proved most promising biocontrol-agent in limiting the population of fruit flies in guava and guava observed most susceptible host for fruit flies in terms of infestation.

Keywords: Trybliographa daci, Guava, Bio-control agents, Fruit flies.

1. INTRODUCTION

Tephritid fruit flies are the most significant fruit pests throughout the cosmos. In Pakistan, there are two species of economic and quarantine importance: the Peach fruit fly, *Bactrocera zonata*, and the Oriental fruit fly Bactrocera dorsalis. These dipteran pests has shown greater adaptability, being distributed in almost over a wide range of climates [1]. Both fruit fly species spell a wide range of commercial crops such as mango, guava, citrus etc. [2]. Annual losses from direct damage are estimated to be 15-20% of fruit production [3]. The occurrence of even a single individual of these species can prevent the exportation of fresh fruit to countries free of these pests due to stern quarantine regulations [4]. Biological control is an environmental friendly control method that has been used against these pests. Parasitoids have been one of the most widely used groups of natural enemies in classical and augmentative biological

control strategies employed against fruit fly species [5, 6]. Among fruit fly parasitoids two important species are the larval cum pupal parasitoids Diachasmimorpha longicaudata (Ashmead) and Trybliographa daci (Weld.) are presently massreared using various fruit fly species as hosts [7]. These parasitoids are easy to manipulate and rear on different fruit fly species and successfully used to control tephritid pests [8]. D. longicaudata and T. daci are being mass-reared at Fruit Flies and their parasitoids lab Plant Protection division Nuclear Institute of Agriculture (NIA), Tando Jam. Controlled releases of parasitoids were performed during different periods and the effectiveness of the programme is being evaluated unfortunately work from Sindh has not been published yet. [9] Our aim of this study was to survey population of the both parasitoids of fruit flies larvae in order to document their availability from different orchard agro-ecosystem of Sindh for the management of tephritid fruit flies.

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2. MATERIALS AND METHODS

The infested fruits from mango and guava orchards of Hyderabad and Larkana region were collected and brought to Fruit Flies and their parasitoids laboratory, NIA, Tando Jam. The infected fruits were placed on sterilized sand in wooden trays covered with fine wire mesh for pupation under controlled laboratory conditions. The observations were made on number of adult fruit flies emerged from unparasitized pupae and number of larval/ pupal parasitoids emerged from parasitized larvae. The adult flies and parasitoids were placed in separate cages ($45 \times 40 \times 40$) and provided with artificial diet.

2.1 Artificial diet ingredients

Sugar, Casein Protein, Honey, and Water soaked cotton were used as artificial diet ingredient.

2.2 Statistical Analysis

All statistical analyses were done with the help of Statistix® Version 8.1, Analytical Software, Inc., and Tallahassee, FL, USA. Statistical analysis was calculated using two-ways analysis of variance ANOVA for different parameters Followed by Tukey's Post Hoc LSD Test for the significance of data.



Fig. 1. Number of adult fruit flies and their parasitoids obtained from infested fruits collected from Mango and Guava orchards of district Larkana.



Fig. 2. Number of adult fruit flies and their parasitoids obtained from infested fruits collected from Mango and Guava orchards of district Hyderabad.

Location and Fruit	Number of Adult Fruit Flies and their parasitoids					
_	B. zonata	B. dorsalis	T. daci	D. longicaudata		
Larkana Guava	288.00 ± 11.57 a	190.60 ± 12.04 b	50.20 ± 4.45 c	30.80 ± 1.49 c		
Larkana Mango	258.0 ± 8.60 a	180.2 ± 12.27 b	35.2 ± 3.08 c	24.2 ± 2.22 c		
Hyderabad Guava	395.6 ± 4.50 a	317.8 ± 5.58 b	62.2 ± 3.03 c	$38.6 \pm 1.48 \text{ d}$		
Hyderabad Mango	331.2 ± 5.82 a	211.6 ± 6.04 b	54.2 ± 2.59 c	$32.2 \pm 3.56 \text{ d}$		

Table 1. Showing (Mean \pm SE) Number of adult fruit flies and their parasitoids obtained from infested fruits collected from Mango and Guava orchards of different climatic zones of Sindh.

Values with the same letters are not significantly different according to Fisher's Least Significant Difference (LSD) test at (P < 0.05).

3. RESULTS AND DISCUSSION

Results revealed that maximum number of larval cum pupal parasitoid *Trybliographa daci* were obtained from the pupae yielded from infested guava fruits collected from Hyderabad region followed by Larkana $(62.2 \pm 3.03, 50.20 \pm 4.45)$. Whereas, low number of *Diachasmimorpha longicaudata* was obtained by infested mango of Larkana and Hyderabad zones; $(24.2 \pm 2.22, 32.2 \pm 3.56)$ respectively.

The significantly higher (P < 0.05) number *Bactrocera zonata* were emerged from infested fruits of guava (288.00 \pm 11.57, 395.6 \pm 4.50) orchards of Larkana and Hyderabad regions as compared to *Bactrocera dorsalis*.

In the present studies the surveillance of larval cum pupal parasitoids (D. longicaudata and T. daci) from guava and mango orchards of Hyderabad and Larkana region were undertaken where no prominent work has been done and published yet on these biocontrol agents. However other authors [10,11] from Huawei recorded the *D. longicaudata* population in higher number during field survey as compared T. daci on contrary we found maximum number of T. daci followed by D. longicaudata in guava and mango orchards of both climatic regions during field visit. Moreover, reduction in the population of oriental fruit fly was found from infested fruits these results are in lined with our results. Interestingly, both larval cum pupal parasitoids emerged from infested fruits were found similar as in our study. During fruit flies and parasitoids associations we obtained similar numbers as described by [12].

4. CONCLUSIONS

In present studies guava was observed most susceptible host for *B. zonata* and *B. dorsalis* in terms of infestation. Whereas, larval/pupal parasitoid *Trybliographa daci* was recorded most promising bio-agent in limiting the population of fruit flies in guava as compared with mango fields in district Hyderabad and Larkana.

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Research Article

Behavior of Camel Browsing Maintained on Vegetation at Desert, Irrigated and Costal Zones of Sindh-Pakistan

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Abstract: Present research focused three major districts viz Mithi, Tando Allahyar and Thatta from Desert, Irrigated and Coastal zones of Sindh Province of Pakistan during the year 2018. Study was subjected to screen and assess the preference pattern of the camel browse vegetations surrounding the study area. Results of present study indicated a total of 16 natural vegetations at Mithi, 16 at Tando Allahyar and 19 at Thatta which were found to be available for browsing by the camels. Further, results reveled Senegalia senegal the most preferred vegetation followed by Cordia sinensis (Linn.), Salvadora oleiodes, and Ziziphus nummularia while, Prosopis juliflora appeared less preferred (p<0.05) followed by Calligonum polygonoides, Orthanthera viminea and Prosopis cineraria at district Mithi. At Tando Allahyar district camel preferred (p<0.05) more to browse the Salvadora oleiodes followed by Suaeda fruticosa, Haloxylon salicornicum and Acacia nilotica and less the Prosopis juliflora, while Tamarix passerinoides followed by Mudhari Tribulus terrestris and Melilotus parviflora were moderately preferred by camels. Further results showed that the Cordia sinensis (Linn.) (p<0.05) was browsed more by camels at Thatta followed by Salvadora oleiodes, Suaeda fruticosa, Haloxylon salicornicum and Prosopis juliflora preferred less. However, Alhagi maurorum, R.mucronata and Timar Avicenia officinalis are preferred by camels at intermediate level. Study concludes that the coastal zone possess significantly ((p<0.05) higher number of natural vagetations for camel browsing comparatively desert and irrigated zones. Senegalia Senegal, Salvadora oleiodes, Cordia sinensis (Linn.) are the most favorite vegetations for camel at all zones but the Prosopis juliflora is less preferred.

Keywords: Browsing, Nutrient, Preference, Surveillance, Vegetation

1. INTRODUCTION

The camel is one of the typical and the best adopted animals of the desert. It is capable of enduring thirst and hunger for several days and is the most patient among all land animals. For desert nomads of Pakistan, it is a beloved companion, a source of milk and meat, transport facility provider and a racing/ dancing animal, thus, playing an important role in the socioeconomic uplift of the local communities [1]. Most of the camel population exist at mainly four distinct ecological zones of Pakistan i.e. Sandy deserts (Thal and Cholistan in the Punjab and Thar in Sindh), Coastal mangroves (Thatta, Badin and Karachi districts of Sindh) and Irrigated plains (all irrigated districts of Punjab and Sindh) [2].

Feeding behavior and chemical composition of the preferred plants is very important aspect to know the biological availability of the feed stuffs and the efficiency of the camel to digest them. Further, understanding the browsing behavior of camels is also essential in order to predict its impact on their nutrient requirements and the vegetation utilization [3-4]. It has been studied that under open range conditions camels are able to exploit wide variety of plants by rapidly moving from one feeding station to the next. Ingestion rates remain

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higher where preferred or selected vegetations are plentiful but are much lower on thorny species having little leaves. Feeding times usually ranges from 15 to 18 hours/day. Camels over browse rarely and they are constantly moving and taking only small portions of each plant. They prefer to browse early in the morning and late afternoon, which are the coolest times of day for feeding [5]. The camels prefer broad spectrum of fodder plants, including trees, shrubs, and sometimes hard-thorny, bitter and halophytic (salty) plants that naturally grow in the desert and semi-arid areas. They generally browse leaves, young twigs/shoots, fruits, flowers and pods. Under natural conditions camels have capacity to choose their forages efficiently, graze more on forage trees than grasses. An important feature of camels' browsing habits is that they are not in direct competition with other domestic animals either in terms of the type of feed eaten or in the height at which they eat above the ground. The greatest competition for feed resources is found between camels and goats, with 47.5% dietary overlap in the dry season and 12.4% in the green (wet) season [6]. Forage quality influences the feeding patterns in camels and that under adverse pasture conditions, the time available for grazing would be a limiting factor for their total dry matter and nutrients intake.

However, according to Kuria et al [7], camels' total dry matter intake needs to be about 4% of body weight and that require as much as 15 or more hours per day feeding on vegetations. It has been estimated that a mature camel weighing 650 Kg requires approximately 26 Kg of dry matter, which might represent between 80 and 100 Kg of total food intake of plants with high moisture contents. In Pakistan, camel generally depends on the natural grazing rangelands for feed. In a study at Cholistan rangeland desert palatability potential of natural browse vegetations were investigated Abdullah et al [8], whereby Prosopis cineraria and Acacia nilotica were reported as highly palatable, Calligonum polygonoides, Suaeda fruticosa, Salsola baryosma, Haloxylon recurvum, Capparis decidua, Calotropis procera and Tamarix aphylla moderately palatable, however Haloxylon salicornicum less palatable. It was also reported that the camel preferred different parts of plants like leaf, shoot, flower, and fruits [9]. Another study was conducted on the effect of age, sex and seasonal variation on forage preference of camel at Sudano-Sahelian zone of north western

Nigeria, where Alkali et al [10] reported that the mature camels consumed mostly diversified, thorny and taller plant species which might not be easily accessed by the camel calves. El-Keblawy et al [11] indicated that camels with their unique anatomical and digestive characteristics browse on a broad spectrum of plant species including those which are normally avoided by other domestic herbivores. The majority of the species reported as preferred by camels were trees and shrubs [12]. In another study Dereje and Uden [13] reported the browsing preference of 240 camels to measure time spent on feeding different plants. The camels preferred a total of twenty one species of plants in the dry and thirty in the wet season. Birhane et al [14] at Aba'ala District, Afar Regional State of Ethiopia reported Acacia oerfota as ranked first followed by Acacia etbaica, Balanites aegyptiaca and Acacia mellifera camel browse vegetations. Although various studies have been conducted on different aspects of the browsing behavior of the camels but in Sindh province of Pakistan such kind of study has never been reported. Present study was therefore planned in order study the availability and preference pattern of different camel browse vegetations at desert, irrigated and coastal zones of Sindh province of Pakistan.

2. MATERIALS AND METHODS

2.1 Location of Study

Current study was conducted in Three different districts viz Mithi, Tando Allahyar and Thatta from Three ecological camel habitat zones like sandy desert, irrigated and coastal mangroves zones of Sindh province [15]. A flow diagram of experimental area is shown in Fig.1

2.2 Experimental Procedure

Present research was conducted during the year 2018 whereby investigation was subjected to comprehensive survey performed at three different districts like Mithi, Tando Allahyar and Thatta of Sindh province as shown in Fig. 1 in order to gather the data regarding availability and preference pattern of different camel browse vegetations. A total of 90 respondents (30 from each district) were randomly selected and interviewed face to face through a uniform pre-tested questionnaire duly divided into



Fig. 1. Flow diagram showing camel habitat zones and vicinities of study area

several parts. The data regarding different camel browse vegetations and their preference pattern were generated and gathered in the current study.

2.3 Statistical Analysis

A computerized statistical package i.e. Student Edition of Statistix (SXW), Version 8.1 (Copyright 2005, Analytical Software, USA) was applied to assess the data. Statistical procedure of completely randomized analysis of variance (ANOVA) under linear models was used to observe the significant variations among the variables within district as well as between vegetations.

3. RESULTS

In order check the surveillance of different camel browse vegetations at Mithi, Tando Allahyar and Thatta districts survey was performed. By using comprehensive questionnaire camel herders were interviewed regarding the availability and preference pattern of different camel browse vegetations at their respective locations.

3.1 Surveillance of Camel Browse Vegetations and their Preference by Camels at Mithi

A total of 30 camel herders were interviewed from district Mithi to record the different camel browse vegetations at the area. Farmers were asked different questions as per questionnaire to gain information about different camel browse vegetations and their rank of preference for camel browsing. According to camel herders a wide

range of vegetations are found surrounding the area of Mithi, while their year round availability vary season to season. Acacia nilotica, Ziziphus nummularia, Acacia jacquemontii, Prosopis juliflora, Cyamopsis tetragonoloba, Cordia sinensis Linn., Indigo pauciflora, Prosopis cineraria, Salvadora oleiodes, Acacia catechu, Orthanthera viminea, Capparis deciduas, Senegalia senegal, Sesamum indicum. Simmondsia chinensis and Calligonum polygonoides were vegetations which were mostly used by camels for browsing at Mithi district (Table 1). Among all vegetations Senegalia senegal preferred significantly more (p<0.05) followed by Cordia sinensis (Linn.), Salvadora oleiodes, and Ziziphus nummularia while, Prosopis juliflora appeared significantly less (p>0.05) preferred followed by Calligonum polygonoides, Orthanthera viminea and Prosopis cineraria (Fig. 2).

3.2 Surveillance of Camel Browse Vegetations and their Preference by Camels at Tando Allahyar

Camel browse vegetations noted during the interviews of camel herders at district Tando Allahyar are illustrated in the Table 2. Table indicates Acacia nilotica; Trifolium alexandrinum; Ziziphus nummularia; Acacia jacquemontii; Prosopis juliflora; Alhagi maurorum; Prosopis cineraria; Salvadora oleiodes; Capparis deciduas; Suaeda fruticosa; *Haloxylon* salicornicum; Tamarix passerinoides; Zea mays; Tribulus Melilotus parviflora; Brassica terrestris: campestris commonly browsed by camels at district



Fig. 2. Preference percentage of different camel browse vegetations at Mithi distirct (desert zone)

S. No.	Local Name	Botanical Name
1	Babur	Acacia nilotica
2	Ber	Ziziphus nummularia
3	Bhair/bairi	Acacia jacquemontii
4	Devi	Prosopis juliflora
5	Guar Kutti	Cyamopsis tetragonoloba
6	Jaar	Cordia sinensis (Linn.)
7	Jhil	Indigo pauciflora
8	Kandi	Prosopis cineraria
9	Khaber	Salvadora oleiodes
10	Khair	Acacia catechu
11	Khip	Orthanthera viminea
12	Kirir	Capparis deciduas
13	Kumbatt	Senegalia Senegal
14	Krur Kutti	Sesamum indicum
15	Morari	Simmondsia chinensis
16	Phog	Calligonum polygonoides

 Table. 1. Survillence of camel browse vegetations at Mithi district (desert zone)

Surveillance and Preference of Camel Browse Vegetation

S. No.	Local Name	Botanical Name
1	Babur	Acacia nilotica
2	Barseem	Trifolium alexandrinum
3	Ber	Ziziphus nummularia
4	Bhair/bairi	Acacia jacquemontii
5	Devi	Prosopis juliflora
6	Kandairo	Alhagi maurorum
7	Kandi	Prosopis cineraria
8	Khaber	Salvadora oleiodes
9	Kirir	Capparis deciduas
10	Lani	Suaeda fruticosa
11	Lano	Haloxylon salicornicum
12	Layee	Tamarix passerinoides
13	Makai	Zea mays
14	Mudhari	Tribulus terrestris
15	Sainji	Melilotus parviflora
16	Sarin/ Sarson	Brassica campestris

 Table 2. Survillence of camel browse vegetations at Tando Allahyar district (irrgated zone)

Table 3.	Survillence	of camel	browse	vegetations	at Thatta	district	(costal	zone)
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S. No.	Local Name	Botanical Name
1	Babur	Acacia nilotica
2	Bago Lano	Salsola foetida
3	Barseem	Trifolium alexandrinum
4	Ber	Ziziphus nummularia
5	Chanar	Ceriops tagal
6	Chor	Aegiceras corniculata
7	Devi	Prosopis juliflora
8	Jaar	Cordia sinensis (Linn.)
9	Jhil	Indigo pauciflora
10	Kandairo	Alhagi maurorum
11	Khaber	Salvadora oleiodes
12	Kirir	Capparis deciduas
13	Kumri	R.mucronata
14	Lani	Suaeda fruticosa
15	Lano	Haloxylon salicornicum
16	Lao	Tamarix orientalis
17	Layee	Tamarix gallica
18	Makai	Zea mays
19	Timar	Avicenia officinalis

Tando Allahyar. However, their occurrence is seasonal. Among the above vegetations camel preferred significantly more (p<0.05) to browse *Salvadora oleiodes* followed by *Suaeda fruticosa*, *Haloxylon salicornicum* and *Acacia nilotica* and less the *Prosopis juliflora* (p>0.05), while *Tamarix passerinoides* followed by *Tribulus terrestris* and *Melilotus parviflora* were moderately preferred by camels (Fig.3).

3.3 Surveillance of Camel Browse Vegetations and their Preference by Camels at Thatta

Vegetations browsed by camels recorded during the interview of camel herders at district Thatta are mentioned in the Table 3. It was noted that the Acacia nilotica, Salsola foetida, Trifolium alexandrinum, Ziziphus nummularia, Ceriops tagal, Aegiceras corniculata, Prosopis juliflora, Cordia sinensis (Linn.)), Indigo pauciflora, Alhagi maurorum, Salvadora oleiodes, Capparis deciduas, R.mucronata. Suaeda fruticosa. Haloxvlon salicornicum, Tamarix orientalis, Tamarix gallica, Zea mays and Avicenia officinalis were commonly browsed by camels at district Thatta. Among the all vegetations, Cordia sinensis (Linn.) was browsed significantly more (p<0.05) by camels followed by Salvadora oleiodes, Suaeda fruticosa and Haloxylon salicornicum and Prosopis *juliflora* preferred less (p>0.05). However, Alhagi maurorum, R. mucronata and Avicenia officinalis are preferred by camels at intermediate

level (Fig.4).

4. **DISCUSSION**

Current study was conducted in order to monitor and assess different camel browse vegetations at Mithi (Desert), Tando Allahyar (Irrigated) and Thatta (Costal). Survey of above said districts was made, and the camel owners were interviewed to collect the data regarding the vegetations for camel browsing. At all three districts a total of 51 vegetations were recorded as being suitable for camel browsing though found 6 fold less than that of reported by Margaret [16], who noted 300 species of trees with potential use as fodder. Nevertheless, he only concentrated on a few (< 10) numbers of species. While in another study, 21 species of plants in the dry, and 30 in the wet season were reported as camel loving vegetations [17-18]. In the present study over camel favored vegetations Senegalia senegal at Mithi, Salvadora oleiodes at Tando Allahyar and Cordia sinensis (Linn.) at Thatta appeared most preferred and the Prosopis juliflora less favored. Reason behind prefer ability of camels towards these plants could be attributed with palatability, nutrients composition and availability of these vegetations. It could be noteworthy that frequent consumption of Senegalia senegal by camels might be due to its palatability which might be because of taste and nutrients composition, although Salvadora oleiodes and Cordia sinensis (Linn.) were also found in



Fig. 3. Preference percentage of different camel browse vegetations at Tando Allahyar district (Irrigated zone)



Fig. 4. Preference percentage of different camel browse vegetations at Thatta district (costal zone)

significant manner surrounding the area of Mithi. Further, *Senegalia senegal* rarely found at Tando Allahyar and Thatta, where *Salvadora oleiodes* and *Cordia sinensis* (Linn.) were most preferred vegetations for camels. It was interest to note that *Prosopis juliflora* was not most palatable vegetation for camels though its consumption proceeded only in scarce time when availability of other vegetations is limited. In contrast to present study, *Prosopis cineraria* and *Acacia nilotica* reported to be highly and *Haloxylon salicornicum* the less palatable camel browse vegetations investigated at Cholistan rangeland desert [8].

5. CONCLUSIONS

Current concludes that the coastal zone possess higher number of natural vagetations for camel browsing comparatively desert and irrigated zones. *Senegalia senegal, Salvadora oleiodes, Cordia sinensis* (Linn.) are the most favorite vegetations for camel at all zones but *Prosopis juliflora* is less preferred compare to all other vegetations.

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Research Article

Ethnomedicinal Study of Plants Used in Phytotherapeutics among Indigenous Communities of District Bhimber, Azad Kashmir and Migrants to United Kingdom

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Abstract: The key purpose of current study was to investigate impact of foreign culture of Britain on traditional herbal medicines on inhabitants and migrants of District Bhimber of Azad Jammu and Kashmir, Pakistan. The current ethnomedicinal (EMs) study was conducted by using questionnaire methodology using structured and semi-structured interview protocols involving 72 interviewees of both genders and age range of 30-100 years. The collected data was analyzed by Informant Consensus Factor (ICF), family index (Fi), fidelity level (FL), data matrix ranking (DMR), Use mode in %age and priority ranking (PR) analyses tools. In this research, total 50 medicinal plants (MPs) were documented as traditional ethnomedicines (TEMs). Euphorbiaceae had highest plant taxa (10) being used as EMs. Leaf was most commonly (21%) used part of plant in TEMs while decoction (32) ranked first in use form. Highest ICF was found for asthma (0.90) and highest FL was shown by Otostegia limbata (95%). DMR showed Acacia modesta at 1st rank for its multiple usages. PR depicted "use of plants for construction" number first (1st) as key biotic threat for medicinal plants (MPs). The analysis depicted that the people purchase and fetch TEMs from their native hometown (Jatlan) or buy from British botanic markets. The study proves that immigrants now living in UK hitherto use TEMs for cure of ailments as complimentary alternative medicines (CAMs). There is less information of TEMs reported by migrants of Bhimber in Western (UK) pharmacological databases and this demand to do further detailed work on ethnopharmacological analysis for rationale use within safety limits and avoid any toxicity implications. Furthermore, young generations of migrants have least interest in CAMs and there is fear of loss of knowledge of MPs of Azad Jammu and Kashmir which demands dire need to document the TEMs data for conservation of cultural and biological diversity of the area

Keywords: Traditional Ethnomedicines, Bhimber, Complimentary alternative medicines, Informant consensus factor, Euphorbiaceae, Data matrix ranking, Azad Jammu and Kashmir, Pakistan.

1. INTRODUCTION

Plants have been known as basic component of ecosystem of earth, which provide main role of producers of food chain. Plants are of keystone worth because these provide oxygen for breathing. Plants provide four basic needs of life directly or indirectly such as food, shelter, oxygen and medicines. Plants have been used as traditional ethnomedicines (TEMs) by the old times civilization of human being and hitherto are being used around the globe. Plants have been used as staple food, food phytonyms and phytomedicines for coping various needs of life [1, 2]. Use of type of plant, its part used and recipe of use is dependent on culture and tradition of society which is inherited from parent generation to youth by oral communication [3]. Sometimes due to amalgam of two or more ethnic groups makes admixture of TEMs and brings novel medicines outcome. The people of any ethnic group or area move to other area due to intentional and planned rhythms or sudden movement/migration or because of catastrophes are compelled to migrate to another city, province or country [4]. Migration

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is natural phenomena occurring due to compulsory or intentional movement of people of one area to other for various reasons. The migration creates amalgam of culture, folklore therapeutics and rituals of migrants with natives. This brings changes in neo-society and people start of be influenced with each other's habits, cultures and copy/adopt traditions of each other creating a harmonized and diverse community origin. Trans-cultural folklore phytotherapeutic brings new issues and challenges for the government health concerned institutions to devise a stable and unisonic policy and agenda to cope with dynamic cultural influence on the native botanic drugs [5].

It is universal that plants on the earth are important for humanity; man uses these in various ways to cope with basic of life. Plants are key drivers of all ecosystems as they act as art of pioneer in ecosystem because they are producers and provide food by process of photosynthesis. All major basic needs of life: food, shelter and health cure medicines are mostly obtained from plants or its byproducts. According to an estimate, it is declared that world's 80% population depends on plants for health cure being promulgated in form different traditional medicine systems [6]. Pakistan's mainstream population is living in rural and mountains areas and they primarily use local plants for treatment of different diseases.

Ethnomedicines are folklore medicines being made from the plants and commonly used by the indigenous people of an area. The medicinal study is covered under subject of ethnobotany, which was coined by Harshberger in 1996 [7]. Ethnobotany focuses on documentation, description of corelationships between cultures and plants of an area, telling that how plants are being used as food, as medicines, in divination, in cosmetics, in construction and in social life of different areas of various countries.

Ethnomedicinal research had begun long ago ca. AD 77, when Dioscorides published his work on MPs in form of book named as "De Materia Medica" with description of 600 plants of Mediterranean zone. It narrated the information about those ancient people that how they used plants for medicinal purposes for cure ailments [8]. The process of documentation of traditional ethnomedicinal knowledge of local people of an area is of key worth as it makes direction of future research for making novel drugs from known MPs of the day. Traditional ethnomedicines (TEMs) have been major source of cure for rural people of Africa like Ethiopia whose 80% population solely depends on plant based medicines to cure different diseases [9]. In world different medicine systems are being used by different cultural societies like traditional Chinese medicines (TCMs), Ayurveda of India, Unani medicines (AUMs), Homeopathy medicines (HMs) of Pakistan and Allopathic medicines (AMs) of western culture. It is declared in an estimate that ca. 2500-3000 plants are used as key resources for TEMs and many of these had been explored for drugs discovery and drug development. The ethnomedicinal study or its knowledge provides basis for pharmacological research and next on pharmaceutical analysis is used for drug making and hence, EMs study is driver of novel drug discovery and drug development [10].

Kashmir is called "paradise" on earth. Allah has bestowed it with many gifts and one of it is that its land has hub of various vegetation species. Azad Jammu and Kashmir is part of the state of Jammu and Kashmir. It was liberated from Dogra rulers of Indian abrogation in month of October, in year 1948. It has an area of 13,297 Km². It lies between 73°C-75°C longitude of 33°C-36°C latitude [11]. District Bhimber Jatlan and allied villages 459m altitude. The climate of the investigated area is of sub-tropical type. Other key survey points were Samahni and Barnala and few from Charhoee are of Kotli. The averages mean maximum and minimum temperature of the area is 28.7°C and 15.5°C, respectively. The average rainfall of the area was 99.4 mm. The average maximum and minimum relative humidity was 70% and 49%, respectively. Dominant casts are Gujjar, Jaat, Rajpoot, Jarral, Malik, Sayyed and Mughal residing in different areas of the area, particularly in District Bhimber of AJK. Research revealed that mostly Gojari, Punjabi, Hindko, Kashmiri, Saraikee and Pothohari are spoken in the area. Urdu and English are also spoken in the area but to some extent but later two languages are official and academic languages of the study area [7]. The key objectives of the research work were as: i) to document and prepare checklist of ethnomedicines being used in local communities of Jatlan area of Bhimber, AJK; ii) to document the ethno-medicines frequently used in

UK by the migrants of AJK from different villages of District Bhimber, iii) to compare the usage of medicinal plants in both societies and explore impacts of culture on these TEMs; and iv) to do analysis of erosion of TEMs in young generation of both sides (countries) and devise conservation measures for future research and reference.

2. MATERIALS AND METHODS

The research was conducted in Jatlan and allied villages of District Bhimber of AJK (some data was collected from various interviewees of different villages to keep heterogeneity and diversity of the research). The data has been collected through interview methods using semi-structured and structured protocols and interviewees comprise of both genders and age of diverse range. The data was collected from inhabitants who have been living in Bradford (UK) for last ten or more years and visit here for once a year. The interviewees were gracious to share their knowledge and experience about ethnomedicines being used in their hometowns (AJK) and new settlement place Bradford (UK). Their mode and trend of dependence on ethnomedicines has been calculated using different micro statistical tools [11]. The interviewees include both gender and age range of 30-80 years, with diverse professional and domestic jobs i.e. herbal drug sellers, shopkeepers, herbal doctors, house women. The preference was given to the people who can speak both English and local languages. The information collected was rationalized by tallying it with online literature available and verifying the data by cross checking by meeting to herbal healers (practitioners of area). The ethnomedicinal plants and other botanic drug specimens were collected from the concerned village sites and herbal drug stores of AJK and similar data was also collected from allied villages. All MPs were collected, identified, named and their herbaria prepared properly. These were placed in herbarium of Department of Botany (MUH), Mirpur University of Science and Technology (MUST) Bhimber Campus, AJK-Pakistan for future reference and study.

2.1 Data Analysis using Micro statistical Tools

The collected data was extracted for refined information, tabulated in matrix form and analyzed

by using micro statistical tools as given below.

2.1.1 Experimental Procedure

The analysis describes the most preferred plant species used for cure of particular disease. FL % was determined by using equation as given by [12]. FL=(Np)/N $\times 100$; where Np is the total number of informants describing the species for curing a particular disease and N denotes total number of informants stating uses of the species for the treatment of any disease. If FL value is high which describes that the given plant species has high use importance for the treatment of specific disease. For elaboration, FL of Otostegia limbata (Benth.) Boiss was found to be 95%, where it means that total number of informants telling about the species for its use to cure a particular disease (Np = 57) and total number of people telling the species for cure of any disease (N=60).

2.1.2 Determination of Informant Consensus Factor (ICF)

Information consensus factor (ICF) was calculated to measure agreement or consensus among the indigenous informants of an area about the uses of medicinal plants (MP) against given disease or group of diseases denoted as category as following the previous work of [13, 14].

ICF=(Nur-Nt)/(Nur-1); where "Nur" is the total number of use citations for each disease and "Nt" is the total number of species used for the treatment of that disease in the study area.

ICF describes the consensus or homogeneity of indigenous ethnomedicinal knowledge among the local informants and it is usually denoted between ranges of 0-1. Where if ICF is near to 1 (one), it indicates that most of the people have similar traditional therapeutic use information for any plant species for given disease [15].

2.1.3 Family Index (FI) Calculation

Family index (FI) was calculated and the highest number of the species of a particular family and the lowest number of taxa of other families were calculated from collected data and described in graphic mode.

2.1.4 Plant Parts Used (PPU)

In the research work, Percentage (% age) of PPU was found from collected data for each group and described in graphical form.

2.1.5 Mode of Use (MU)

Percentage (%age) of use mode of plant in form different recipes was also determined and presented in chart or graph form.

2.1.6 Calculation of Data Matrix Ranking (DMR) & Priority Ranking (PR)

DMR and PR methodologies were used to determine popularity the of plant species in the local communities, their multiple usage, biotic pressure and conservation level or status of various species in the area.

3. RESULTS

The plants are very significant and have pivotal role in life of man and particularly communities of rural areas are mostly dependent on plants for fulfilling of their life basic needs. The plants are good source of ethnomedicines (EMs) and are being used in rural communities as tonic to cure different ailments and chronic diseases since old times. The individual enumeration of each medicinal plant (MP) with its recipes is prescribed here below. The data generated through the interviews methodologies is tabulated and analyzed with relevant statistical tool Table 7.

3.1 Information of Indigenous People

In this study of comparative analysis, local people of District Bhimber, AJK and migrants of some families or members to UK was made on the basis of quantitative ethnobotanical analysis using provident research protocols. The information was collected from the local people residing in different villages of District Bhimber viz: Jatlan, Sokason, Bindi, Chowki, Samahni and other some rural areas of District Bhimber of Azad Jammu and Kashmir were also incorporated in the study. The purpose was to know the common popularity and use potential of different medicinal plants of the area. The second aspect was to note-down the traditional medicine uses of plants from the people who were migrants (migrated to Bradford, UK) but still they use herbal therapeutics as learnt from hometowns of AJK when they come back or even live there. The data were collected from migrants who came back to Bhimber (AJK) and living here for few months (with their parent families). A good total of 240 informants was used as model with high diversity containing both genders with various age groups were included (Table 1) to keep the heterogeneity in the study. The botanic drug healers (hakims) were also included in the survey to consolidate the data/ information [11]. It was found that older people had more knowledge of botanic drugs and they prefer to use traditional herbal tonic and recipes as learnt from their ancestors (Fig.1 & Fig. 2).



Fig. 1. A distribution of traditional ethnomedicinal knowledge by ages among Local Bhimber Communities and migrants to Bradford.

Interviewees	Age	Categories (years)	Total number of informants
	20-40	>40-90	
Male	45	55	100
Female	20	65	85
Local herbal healers	10	45	55
Total			240

Table 1. Information of Interviewees about their age and gender during survey of Ethnomedicinal of District Bhimber of Azad Kashmir (Local and UK Migrants Inhabitants)



Fig. 2. Family Index of Study Area of District Bhimber of Azad Kashmir (Local and UK Migrants Inhabitants)

3.2 Data of Medicinal Plants and Their Family Index

In the study, 50 medicinal plants (MPs) of high value and prevalent use were included in the research work. These plants belonged to 28 families and family index was calculated which depicted that family Euphorbiaceae was ranked one (10 %), Moraceae and Solanaceae were at second (8%) each and Apocynaceae, Lamiaceae and Papilionaceae were at number three (6% each) as shown in Table 2 and Fig. 2. The common occurrence of Euphorbiaceae was due to its high population and low palatability by livestock and rodents. This family plants have latex which is also repellent of many pests and other insects. The second number families Moraceae and Solanaceae which had mostly trees (as reported in the study) as MPs and these can bear harsh climate and are perennial in nature having long life span [7].

3.3 Surveillance of Camel Browse Vegetations and their Preference by Camels at Thatta

Different parts of MPs have been used as traditional medicines by the local and the migrants people of Bhimber, AJK. Leaf, root, flower, and fruit are used commonly in this practice. It was found that leaves were mostly used in different herbal medicine recipes with percentage of 21%, followed by fruits (15%), root and flower (12%) each while 10% of seed and whole plant. Latex, was the part of the plant that was rarely used as (5%), due to the secretion of gum or of a few specific group of MPs only (Table 7; Fig. 3). The reason of using leaves in high percentage is due to the presence of high metabolic rate and phytochemicals [16, 11, 17]. One other reason for the frequent usage of leaf is the easy access and all time availability [18, 19]. The fruit was also popularly used as herbal tonic or form and it was due to easy accessible and easy to use or eat without any preliminary drug formation

Family	Number of Plants	% age	
Acanthaceae	1	2	
Anacardiaceae	1	2	
Apocynaceae	3	6	
Asteraceae	2	4	
Combretaceae	1	2	
Cuscutaceae	1	2	
Ebenaceae	1	2	
Fumariaceae	1	2	
Euphorbiaceae	5	10	
Lamiaceae	3	6	
Lythraceae	1	2	
Malvaceae	1	2	
Meliaceae	2	4	
Mimosaceae	2	4	
Moraceae	4	8	
Myrtaceae	2	4	
Nyctaginaceae	1	2	
Sapindaceae	1	2	
Solanaceae	4	8	
Papilionaceae	3	6	
Phytolaceae	1	2	
Palamaceae	1	2	
Punicaceae	1	2	
Rhamnaceae	2	4	
Rosaceae	2	4	
Rutaceae	1	2	
Verbenaceae	1	2	
Violaceae	1	2	
Total 28	50		

 Table 2. Family Index of Ethnomedicinal Study of District Bhimber of Azad Kashmir (Local and UK Migrants Inhabitants)

procedure [11].

Indigenous people use plant parts in different recipes and the mode of preparation is very sophisticated depending on cultural traditions of the area. The MPs are commonly used in the form of decoction, tea, extract, powder, gum, latex, infusion, poultice, fruit and paste. The mode of use or recipe type depends on the type of the plant parts being used. In fact, the culture of the ethnic groups also influences their usage. [20]. The highest form of use of MPs was in form of decoction (32) followed by powder (30), seeds (27) and tea (25) and it is also presented in figure form (Figs. 3; 4). The decoction was shown the best and common way of MPs use in herbal cure which may be due to reason that during decoction formation (heating of plant parts in liquid) produce out more phytochemicals and people prefer it good mode of use with better relieve as shown in Table 7 [21]. The form of usage was powder which is easy to prepare and engulf with water or any liquid as prescribed by practitioners. The various people use tea or gum or poultice to cure different disease and it depends on the type of disease and mostly on traditional culture of the indigenous people of an area [19].

3.4 Informant consensus factor (ICF)

In the study all plants species used were categorized into 17 diseases which were commonly cured by using traditional methods from MPs of District Bhimber of AJK (Table 3). Highest ICF was found for asthma (0.90), followed by flatulence (0.88), diabetes (0.84), Hypertension (0.75), toothache (0.72). The least ICF was found for constipation (0.20). The high value of ICF proves that concerned diseases is effectively treated by local people using folklore therapeutics in Bhimber (AJK) and UK and these findings are corroborative with previous works of [22, 23]. High ICF value also indicates that there is good agreement among the local and migrant informants about the use of different herbal drugs obtained from MPs of local area of District Bhimber. While in contradictory form, when there is low ICF, it means that there is less consensus among the informants the use of particular treatment for cure of the disease or it may indicate that particular is very rare in the study area, which is coincides with past work of Teklehaymanot and Giday, (2007) [24]. In the analysis, mostly high ICF was found for many disease categories as described in Table 4, that might be due to high medicinal values for particular disease [25]. Generally, it is recognized by indigenous communities of the area that MP which has multiple uses is best one for curing different diseases [26, 27].

3.5 Fidelity Level (FL%)

The study revealed that highest value of fidelity value (FL%) was found for Otostegia limbata (95%), followed by Azadirachta indica (91.66%), Acacia sena (86.66%), Boarhavia diffusa (85%), Lawsonia innermis (83.33%), Malva parviflora (81.66%), Morusnigra (80.00%) and Euphorbia hirta (78.33%) as shown in Table 4. The high value of FL depicts the most preferred species of MP to cure a particular disease in study area [28]. This also tells that plants, which are more prevalently used by indigenous people, have higher value of FL. FL is also known as best tool to select a particular plant for future ethnopharmacological and pharmaceutical research based on ethnomedicinal preliminary research work indicating highest FL% to cure a certain disease [29]. It is recommended in the past research that plants with high FL% has good potential for further phytochemical analysis because these plants contain more potential phytoconstituents and it is also coincided with work of Hassan, et al., (2013) [30]. In table 5, some plants depict low FL such as Acacia arabica (25%), Zizyphus nummularia (23.33%), Zizyphus jujuba (36.66%) and this might be due less information of



Fig. 3. Percentage of Plant Parts Used by Local People of District Bhimber of Azad Kashmir (Local and UK Migrants Inhabitants)



Fig. 4. Mode of Preparation and Use Reported by Local People of District Bhimber of Azad Kashmir (Local and UK Migrants Inhabitants)

these plants for cure of particular disease in the area [31, 32]. It might be due to reasons that these plants are not preferred for treatment of certain diseases in the research area communities or may be knowledge of these MPs to cure the ailment is eroded due to barrier in transfer of traditional knowledge from one generation to next or effect of new culture as on migrants' communities of Bhimber who went to UK and similar results were stated by [33].

3.6 Data Matrix Ranking (DMR) and Priority Ranking (PR)

In the study, DMR and PR statistical analyses were calculated to infer the current biodiversity conservation status of the MPs in the study area. DMR depicted that many MPs of the area albeit very commonly used in ethnomedicines but also people of the villages use these plants to cope their domestic needs i.e. construction of shelter/home, hedging, fencing, fodder, fodder and fruit (Table 5). Thus demarcates that there is severe biotic pressure on these MPs and many of these have been reduced to threatened level [11]. This study also describes that alternative uses of these MPs may be controlled to cope the needs of ethnomedicines of rural areas. If multiple usages in none-ethnomedicines (NEMs) remained incessant, it will lead loss of population and many taxa of important worth from the area. The analysis showed that Acacia modesta is under severe threat with 1st in DMR, followed by *Zizyphus jujuba* (2nd), *Zizyphus nummularia* (3rd) and *Terminalia belerica* (4th) in rank of multiple usages [7].

The priority ranking (PR) data showed that anthropogenic threats like construction is at number first (1st), fuel and fodder (2nd) and agriculture land expansion by cutting of trees and plants of wild land is at 3rd level (Table 6). The rural people use plants particularly trees for construction of their homes and their livestock sheds and cottages. The cutting of trees for household items leads towards to the loss these species from the study area causing

Table 3. Informant consensus factor for most prevailing diseases as told by interviewees of District Bhimber of Azad Kashmir (Local and UK Migrants Inhabitants)

Disease Name	Number of Use Report (Nur)	Number of Species (Nt)	ICF
Diabetes	20	4	0.84
Stomachache	13	6	0.58
Toothache	12	4	0.72
Hypertension	9	3	0.75
Jaundice & Hepatitis	10	6	0.44
Cough	10	5	0.55
Diarrhea	16	6	0.64
Leprosy	9	4	0.62
Asthma	11	2	0.90
Cancer and Tumor	6	3	0.60
Skin diseases	17	7	0.62
Eye Irritation	12	4	0.72
Constipation	11	9	0.20
Flatulence	28	4	0.88
Ulcer	16	5	0.73
Dysentery	16	6	0.65
Liver Problems	15	4	0.78

Diseases	Local Name	Botanical Name	Family	Np	F.L
Diabetes	Kikar	Acacia arabica L.	Mimosaceae	15	25.00
	Jand	Zizyphus jujuba	Rhamnaceae	22	36.66
	Bair	Zizyphus nummularia	Rhamnaceae	14	23.33
Stomachache	Podina	Mentha arvensis	Lamiaceae	16	26.66
	Gandeera	Nerium oleander	Apocynaceae	11	18.33
	Cheechra	Butea monosperma	Combretaceae	13	21.66
	Amlok	Diospyros kaki	Ebneceae	13	21.66
	Timmber	Zanthoxylum alatum	Rutaceae	44	73.33
Toothache	Phulai	Acacia modesta	Mimosaceae	33	55.00
	Dareek	Azadirachta indica	Meliaceae	55	91.66
	Sanatha	Dodonea viscosa	Sapindaceae	41	68.33
	Cheetibooti	Otostegia limbata	Lamiaceae	57	95.00
Jaundice	Kikar	Acacia sena	Papilionaceae		52
	Snati	Boarhavia diffusa	Nyctaginaceae	51	85.00
	Doodal	Euphorbia hirta	Euphorbiaceae	47	78.33
	Mehndi	Lawsonia innermis	Lythraceae	50	83.33
Cough	Kala toot	Morus nigra	Moraceae	48	80.00
	Sonchal	Malva parviflora	Malvaceae	49	81.66
	Banafsha	Viola odorata	Violaceae	42	70.00
	Dudhi	Euphorbia hirta	Euphorbiaceae	33	55.00
	Podina	Mentha arvensis	Lamiaceae	4	06.66

Table 4. Fidelity Level of Plants in study area used for Cure of Different Aliments as told by interviewees of DistrictBhimber of Azad Kashmir (Local and UK Migrants Inhabitants)-(Total Informants=60)

Table 5.	Direct Mat	rix Rankin	g (DMR)	of plant	species	of District	Bhimber	of Azad K	Kashmir	(Local	and	UK
Migrants I	Inhabitants)	with other	uses than	medicina	l value (total score	is from 50	informants	s) in the	study a	rea	

Sr.#	Plant spp./Uses	Construction	Hedge, Fencing	Fire wood	Cash income	Fodder	Fruit, Food	Total	Rank
1	Acacia modesta	Total		41	05	30	00	161	1 st
2	Nerium oleander	Rank	40	15	00	05	00	80	10^{th}
3	Phyllanthus emblica	05	00	00	45	10	44	89	9^{th}
4	Phoenix dactylifera	00	15	11	35	00	40	101	6^{th}
5	Punicagranatum	05	05	10	30	20	45	105	5^{th}
6	Ricinus communis	00	05	00	00	15	00	20	14^{th}
7	Terminaliabellerica	35	15	10	25	10	20	115	4^{th}
8	Viola odorata	00	00	00	45	00	00	45	13^{th}
9	Zanthoxylumalatum	10	05	05	20	10	10	60	12^{th}
10	Zizyphus jujuba	10	35	30	20	25	20	140	3^{rd}
11	Zizyphusnummularia	10	20	25	15	35	40	145	2^{nd}
12	Justicia adhatoda	20	25	35	00	10	00	90	8^{th}
13	Acacia modesta	15	20	25	00	10	00	70	11^{th}
14	Azadirachta indica	25	15	15	00	25	00	80	10^{th}
15	Acacia arabica	20	15	35	00	25	00	95	7^{th}

Table 6. Priority Ranking (PR) of narrating different threats factor to medicinal plants (MPs) biodiversity based on multiple usages posing destructive pressure on MPs in the study area of District Bhimber of Azad Kashmir (Local and UK Migrants Inhabitants), Destructive Threat Order (DTO) is: 6<5<4<3<2<1; where 6 is the most destructive value and 5 is second highest value and subsequently others shown)

Threat Factors		Respondents (R1-R6)					Total	%age	Rank
	R1	R2	R3	R4	R5	R6			
Construction	10	8	4	7	6	5	40	19.80	1 st
Fuel & Fodder	6	8	5	7	6	5	37	18.31	2^{nd}
Urbanization	4	6	8	6	4	3	31	15.34	5 th
Agriculture expansion	7	4	5	6	7	4	33	16.33	3 rd
Timber mafia/export	8	6	4	3	4	7	32	15.84	4 th
Fire	6	2	6	3	6	4	26	12.87	6 th

 Table 7. Ethnomedicinal Study of Plants Used in Phytotherapeutics Among Indigenous Communities of Districts

 Bhimber, Azad Kashmir and Migrants to United Kingdom

Sr. No	Species Name	Family	Local Name	Common Name	Speci- men No	Loca- lity	Plant Parts Used	Usage mode	Ethnomedicinal Uses
1	Acacia arabica L.	Mimos- aceae	Kiker (Tree)	Babul	MUH- 1652	(Peer Gali)	Branches bark and gum	Gum, extract and Powder	Gum: diarrhea, dysentery, diabetes & male-sterility Bark: astringent and demulcent & cure bleeding piles and cold. Branches: tooth cleaning. Gum is used for cure of.
2	Acacia modesta Wall	Mimos- aceae	Phulai (tree)	Hook thorn	MUH- 1658,	(Samahni /Poona),	Bark, root, gum, seed	Gum, decoc- tion, tea	The gum of the plant is used as energizer, tonic and stimulant to keep body active. Small and soft branches or twigs of A. modesta are used to clean the teeth (miswak). Fresh branches are used as fodder. The gum is mixed with desi ghee (cow butter) and seeds of almond for cure of backbone pain. Bark is known as herbal tonic for diuretic in nature and its decoction is used for cure of bacterial infections, bleeding of gums, and wounds healing. The fruit is used for the cure of leprosy and burning with other herbs is used as ritual tonic for cure of venereal diseases
3	Acacia sena L	Papilion- aceae	Kiker (Shrub)	Wattles	MUH- 1627	(Jatlan)	Flowers and leaves	Fruit, Gum, Deco- ction	It is used for skin and tooth problems. It is also used as fuel and fodder for livestock. Its gum is used for antiseptic and wound healing. Its seed extract is used in form of decoction to cure sore throat and cough. It reduces the body fats and relieves pain.

4	<i>Azadira- chta indica</i> (L.) A. Juss	Meli- aceae	Neem (tree)	Indian lilac	MUH- 1618	(Jatlan)	Leaves & fruit	Deco- ction, oil	Oil is used for skin care such as acne treatment and keeping skin elasticity. Leaves are used in wounds and reduced all inflammation. The fruit used in skin diseases, tumors and toothache.
5	Boarhavia diffusa L.	Nyctagin- aceae	Santi (Herb)	Spreading hogweed	MUH- 1688	(Bhimber/ Sokason)	Leaf, root & whole plant	Tea, powder, decoction	Roots extract is commonly used in anemia and jaundice. Leaves powder is used in oedema, inflammation and eye diseases problems. Its whole plant decoction is used in cure of urinary problems and encephalitis disease. The decoction of leaf and stem is useful in cure of leucorrhoea and joint pains.
6	Butea monos- perma L.	Papilion- aceae	Chichra (Tree)	Flame of Forest	MUH- 1624	(Jandi Chontra)	Root and Leaves	Deco- ction, Powder	Leaf extract is externally is used for pimples. It is used for dysentery and for being young. It is used for joint pains or gout and its decoction is also used as diuretic. It is also used as powder form as anti-ulceric and stomachic.
7	<i>Calotrop- isprocera</i> (Aiton) Dryand.	Apocyn- aceae	Aak (Shrub)	Crown flower	MUH- 1710	Bindi (Samahni)	Whole herb, Latex	Latex, powder	The milky latex is used in snake-bite cure. Its flower extract is used for curing ear pain. The lea poultice is used for treatment of skin infections.
8	<i>Carissa opaca</i> Stapf. ex. Haines	Apocyn- aceae	Granda (Shrub)	Currant Bush	MUH- 1660	(Samahni /Bindi)	Leaf, Fruit and stem	Fruit, latex, decoction	The milky latex is used as antioxidant and antimicrobial tonic. Its root extract is known for anti-cancer, cytotoxic and anti-diabetic properties. Its leaf decoction is used as antipyretic, hepatoprotective and anti-inflammatory by local communities.
9	Colebr- ookea opposi- tifolia Sm.	Lami- aceae	Chiela (Shrub)	Indian Squirrel Tail	MUH- 1729	Chahee (Samahni)	Leaf and Fruit	Extract, Paste	Leaf extract is used for curing wounds cure. Young leaves' and fruit paste is used as fish killer as bating/catching fish technique in villages. Its leaf extract is used as ant- helminthic and antiseptic. It is used to cure dermatitis, nose bleedings and killing of ringworms.
10	<i>Cuscutare</i> <i>flexa</i> Roxb.	Cuscut- aceae	Akasbel (Herb)	Devil's Hair	MUH- 1705	(Sokason)	Whole herb	Whole plant	The decoction of whole plant is used get relief of sores pain. Its powder is known as purgative, constipation, fever and anthelmintic. It is a cold tea is used to cure liver and

spleen disorders.

11	Datura innoxia Mill.	Solan- aceae	Datura (Tree)	Downy thorn	MUH- 1673	(Jatlan)	Dried leaves, seeds and fruit	Decoction, powder, juice	The fruit powder is used as narcotic and sedative. To cure chest and breath issues leaf is burnt and smoked which is also good tonic for cure of asthma. Leaf infusion is dropped in earache. The fruit juice and leaves are good for curing dandruff and hair loss.
12	<i>Dodonea viscosa</i> (L.) Jacq.	Sapind- aceae	Sanatha (shrub	Soap- wood	MUH- 1634	Gora Nakka	Leaves, fruit	Extract, powder	The leaves are chewed for toothache. Tanin /extracts are used externally to heal wounds and insect bites. Fruit can be used as a replacement for hops brewing beer. In hot, dry area, the shrub is used as windbreak to prevent soil erosion. It is also used as fuel. It is used for teeth cleaner.
13	<i>Diospyros kaki</i> Thunb.	Eben- aceae	Amlok (tree)	Persim- mon	MUH- 1721	Garhoon (Samahni)	Leaf, Root & Whole Plant	Decoction, powder	Its root decoction is used in stomachic. The leaf extract is useful in soar throat cure. The fruit of plant is used as laxative and constipation. The juice of fruit is known as refrigerant and commonly thought as very useful for curing dyspepsia.
14	Eugenia jambulana L.	Myr- taceae	Jaman (tree)	Black plum	MUH- 1699	(Jatlan)	Leaves and fruits	Fruit, deco- ction, tea	It fruit is used to cure diabetic problems. It is also used in diarrhea and in-digestion disorders with symptoms of flatulence. It is very effective in disease of bronchitis and asthma.
15	Euphorbia hirta L.	Euphorbi- aceae	Dudhi (herb)	Booti	MUH- 1670	Bhimber	Entire plant	Tea, powder	Whole plant's decoction is used in diseases of children in worms, bowel complaints, cough and dysentery. Leaf tea of plant is used in bronchial affection and asthma.
16	Euphorbia prostrata Ait.	Euphorbi- aceae	Dudhi (herb)	Spurge	MUH- 1672	Bhimber	Whole plant	Tea, powder	Internal use of sap is a drastic purgative. The substance is used to treat diarrhea and skin irritation. Its tea is useful for cure of bleeding hemorrhoids and other wounds.
17	Ficus carica L.	Moraceae	Anjeer (tree)	Fig	MUH- 1620	Bhimber (Rajani)	Fruits, Latex, leaves	Latex, Fruit, Paste	Milky latex of leave is used for cure of nail pains. Fruit extract is for cure of constipation and urinary bladder disorders. It is considered as holly tree and its fruit is also eaten as cardio tonic. It is stated as folklore tale or myth that if someone sees flower of fig, he will become rich soon in future.
18	Ficus palmata L.	Moraceae	Phagw- arra (tree)	Fig	MUH- 1666	(Samahni)	Fruit, bark and latex	Latex, powder	The fruit of fig if eaten regularly it makes digestive system laxative and removes pain of constipation. The milky juice of plant is used to treat insect bite and stings.
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19	Fumaria- indica (Hausskn.) Pugsley	Fumari- aceae	Papra (herb)	Indian Fumitory	MUH- 1704	(Jatlan)	Leaf and whole plants	Tea, Decoction	The decoction whole herb is applied to cure leprosy, jaundice, and dyspepsia. It is used in eczema and diuretic disorders. Its tea is used as diaphoretic and laxative for cure of chronic constipation.
20	<i>Indigofera heterantha</i> Wall. ex Brandis	Papilion- aceae	Jhand (shrub)	Indigo Bush	MUH- 1734	Kadorah (Bhimber)	Fruit and stem bark	Decoction, Paste	Ethnomedicinal Uses: Its fruit is boiled and used pickle for eating food. Paste of stem bark is prepared in olive oil and used as plaster on scabies problems.
21	Justicia adhatoda	Acanth- aceae	Baiker (shrub)	Malabar nut	MUH- 1646	(Jatalan)	Leaves, flowers and roots	Fruit, extract, decoction	Flower decoction is useful decoction for asthma. Flowers paste is used for cough treatment. Leaf paste is applied to relief pain. Juice of roots of this plant is given to relief from fever and scorpion bite. Root and leaf extract is used as expectorant to release phlegm. It is used to get relief of bronchitis and cold.
22	Lawsonia innermis L.	Lythra- ceae	Mehndis (shrub)	Migno-nette tree	MUH- 1657	(Bindi/ Bhimber)	Leaf, seeds, bark and flowers	Fruit, Powder, decoction	Powdered seeds of plant give relieve in dysentery bowls. Bark extract is used to cure jaundice and yellowness of eyes. Henna flowers powdered very good to cure headache. The root decoction is taken in burning sensation and leprosy problems. Powdered leaves are useful in wounds healing, boils and burns of body. Its is leaf and bark powder is used dye hairs and its seed oil is very commonly used in perfume industry.
23	Malva parriflora L.	Malva- ceae	Sonchal (herb)	Mallow	MUH- 1681	(Jatalan)	Lead and seeds	Tea, poultice, decoction	Its leaves are used as emollient. Seeds are used as decoction in cough. It is effective herbal medicine to treat bladder ulcers. Its leaves are warmed and cooked in oil and used as poultice to cure joint pains and swellings of knees.

24	Mallotus philipp- ensis (Lam.) Müll.	Euphorbi- aceae	Kameela (shrub)	Monkey- puzzle	MUH- 1728	Kalch (Samahni)	Leaf, Flower and Inflores- cence	Decoction, extract, powder	Leaf twigs' extract is used for curing vermicide of livestock. Young leaves' paste and poultice is used in treating skin infectious diseases. Inflorescence and fruit powder is useful as pesticide to kill jackals, which damage crops, and its small quantity is used to kill intestinal worms of rodents.
25	Mangifera indica L.	Anacardi- aceae	Aam (tree)	Mango	MUH- 1610	(Jatlan)	Leaves and Fruit	Pickle and decoction	Fruit is very delicious, tonic, vigour giving, carminative and appetizer. Its raw fruit is good for pickle making which is used as appetizer. Inflorescence used for killing calf worms.
26	Melia azadarach L.	Meli- aceae	Draik (tree)	Indian lilac	MUH- 1677	(Bindi/ Samahni)	Leaf and seeds	Powder, Tea, extract	Leaf decoction is very commonly used as antiperiodic and anthelmintic and diuretic. Leaves extract is used in anemia, measles and jaundice treatment. Leaves paste is used in wounds and pimples curing.
27	Mentha arvensis L.	Lami- aceae	Podina (herb)	Mint	MUH- 1631	(Jatlan)	Whole plant	Extract, sauce	The entire plant is antibacterial. It is used in cough, core throat, vomiting and diarrhea. It is also used for stomach problems and it is carminative. The sauce of leave and stem is used as sedative, emmenagogue and astringent.
28	Morus alba L.	Mor- aceae	Toot (tree)	White Mulberry	MUH- 1643	Bindi (Bhimber)	Fruits, leaves, branches	Syrup, Decoction, Fruit	Fresh fruits of tree are eaten as wild fruit for villagers. Fruit eating is known as laxatives and purgative. Leaves are used for throat rashes, anthelmintic and astringent purposes. Leaves were once used in rearing silkworm.
29	Morus nigra L.	Mor- aceae	Kala Toot (tree)	Blackberry	MUH- 1644	Jandala (Bhimber)	Leaves, fruits, branches, wood	Syrup, Decoction, Fruit	Fruits of the tree are eaten for cure of constipation and these are laxative. Syrup of fruit is prepared which is used to cure chronic whooping cough and sore throat.
30	Myrtus communis L.	Myrt- aceae	Myrtle (shrub)		MUH- 1615	(Charohee	Leaves and Fruits	Decoction, Leaf paste	Myrtle leaf use as ingredient cough syrups to treat chest infection, congestion and disorders of the urinary tract. Oil and leaves are applied externally to treat wounds, acne and gum diseases.
31	Nerium oleander L.	Apocyn- aceae	Gandera (Shrub)	Oleander	MUH- 1612	(Sokason)	Leaves	Decoction, Tea	Leaves tea traditionally used to treat functional disorder of the stomach and liver. Externally, used to treat skin rashes and scabies.

32	<i>Otostegia</i> <i>limbata</i> (Benth.) Boiss	Apocyn- aceae	Safeed Sumbali (Shrub)	Periwinkle	MUH- 1731	Barnala (Bhimber)	Leaf and Root	Powder, decoction	Its leaf decoction is used as antiseptic, anti-renal disorder cure, toothache reliever. Its root powder is used to cure headache, diabetics, and anti- hyperlipidemia issues
33	Phyllanthus emblica L.	Euphorbi- aceae	Amla (tree)	Indian gooseberry	MUH- 1611	(Toneen)/ Saamhni	Fruit, Flower and Seeds		: Its fruit is known as cooling, diuretic and asperative. Seeds are used in the asthma and bronchitis. Flowers are refrigerant. Its fruit is also cooked asdish, used to make marrabba amla, also used to make pickles of amla.
34	Phytolaca oleracea L.	Phytol- aceae	Khajoor (tree)	Kulfa	MUH- 1645	Bhimber	Fruit, leaves	Decoction, Juice, powder	Fruit is used as thermogenic. The fruit juice is taken to control or lower down the blood pressure of patient. Its fruit extract is used for joint pains and rheumatism. Leaf powder is used as tonic of skin problems.
35	Phoenix dactylifera L	Palam- aceae	Anaar (Shrub)	ates	MUH- 1687	(Tonin/ Samahni)	Fruit, root and gum	Fruit, root and gum	Fruit is very delicious and its fresh fruit juiced is coolant. The fruit is laxative and it has high content of calcium and energetic. Its gum is used for treating urinary infections, diarrhea and asthma. Its root powder is aphrodisiac, nutritive and good for cure of fever and cough. Its leaf decoction is used for cure of chest pains and gonorrhea.
36	Punica granatum L.	Punic- aceae	Gulab (shrub)	Pomegr- anate	MUH- 1632	(Rayayal)	Fruit, bark, leaves	Decoction, powder	Leaves extract is used to skin diseases. Its fruit is known as astringent and blood purifier. Fruit pericarp is burnt and commonly used with raw sugar (gor) for treatment of whooping cough. Dried seeds are called as "anardana" as spices in making dishes. Bark of stem and root is boiled and its decoction is effective to cure stomach worms, mouth bad breathings and expectorant of phlegm.
37	Rosa indica Mill.	Ros- aceae	Gulab (shrub)	Rose	MUH- 1635		Flowers, Leaf and Root	Paste, extract, Tea	Rose petals reduce high cholesterol. Rose water a valuable lotion of inflamed and sore eyes. It is also useful to improve sore throat and enlarged tonsils. It also used perfumes. It is used for face wash and feet cleanser.
38	Ricinus communis L.	Euphorbi- aceae	Akhrey (shrub)	Castor oil plant	MUH- 1625	(Samahni)	Leaves, roots and seeds	Oil, Fruit, Extract	Seed oil is good tonic for joint pains and rheumatism. Its massage is used in paralysis treatment for early recovery. Fruit juice is used cooling agent for relieving body heat. Leaf poultice is prepared with ghee/oil and used on boils and swellings to get rid of it sooner.

39	Rubus fruticosus L.	Ros- aceae	Akhrey (shrub)	Black berry	MUH- 1733	Charhoee	Leaf, Fruit and Root	Extract, powder	and r mount it. Roc curing ulcers, whoop powde anemia root e treatm niles
40	Solanum nigurm L.	Solan- aceae	Mako (herb)	Black Night- shade	MUH- 1637	(Sairla/ Bhimber)	Whole herb	Decoction, Powder	Plant of diureti Leaves hey-fe Juice constip plant i extract effecti Root leaves
41	Sonchus arvensis L.	Aster- aceae	Kor (herb)	Swine thistle	MUH- 1648	(Jatalan)	Root and leaves	Tea, extract, poultice	diureti bronch poultic inflam paste rapa I cure of roo bronch pains i
42	Solanum surrattense L.	Solan- aceae	Mokari (shrub)	Wild eggplant	MUH- 1682	(Bindi/ Samahni)	Fruit, Whole plant	Tea, powder, poultice	Fruit used f plant Chest soar t root constij disease is used and ar root e helmir belly i
43	<i>Taraxacum</i> officinale Weber ex. Wigg.	Aster- aceae	Handh (herb)	Dand- elion	MUH- 1668	(Sairla/ Bhimber)	Leaf and root	Tea, powder	Its lea stomac comple is used proble also us and ki Dande for d

Its fruit is used as cure of chronic constipation. Wild and rural communities of mountains also commonly eat it. Root decoction is used in curing of sore throat, mouth ulcers, gum bleedings and whooping cough. Its leaf powder is used for curing anemia and diarrhoea. Its root extract is also used in treatment of hemorrhoids and piles.

decoction is known as ic and cardiac, tonic. spowder is used to cure ever and stomach ulcer. of herb is useful in pation, acne. The whole is crushed and juice or t obtained which is ive in cure of flatulence. useful in jaundice -cooling, sedative, ic, useful in cough, hitis, asthma. Leaf ce is used to cure joints mation and pains. Leaf with seeds of Brassica L. powder is used for of tough breast. Tea ots is used for cure of hitis and other cold in chest.

Fruit is cooked which is used for joint's pain. Whole plant decoction is used in Chest infection bronchitis, soar throat and cough. Its root powder is used in constipation and dropsy disease. Dried fruit powder is used as anti-inflammatory and antispasmodic cure. Its root extract is used as anthelminthic to kill worms of belly in children.

Its leaf powder sis used for stomach, liver and rheumatic complaints. Its leaf decoction is used for cure of gallbladder problems. Root powder is also useful in antitumor cure and killing of wound germs. Dandelion tea is very useful for diabetic patients. Its power is useful for body tonic because it has many minerals and vitamins in it.

44	<i>Terminalia bellerica</i> (Garten) Roxb	Combret- aceae	Baira (tree)	Belliric myro- balan	MUH- 1654	(Bindi/ Samahni)	Bark, Fruit and Leaves	Powder, decoction, tea	Its root's bark decoction is used for skin diseases. It is also as used fuel. Its fruit is very useful to cure leprosy, cold, bronchitis and other respiratory diseases. Its fruit outer coat is used for carminative purpose and it is digestive and cure flatulence. Its fruit is powder with Phyllanthus emblica fruit and it is the best tonic and health harmonizer for strong body. Its seed kernels are used as antidiarrheal, antileprotic.
45	Viola odorata Sm.	Viol- aceae	Bana- fsha (shrub)	Sweet viole	MUH- 1685	(Sarooli/ Bindi)	Whole herb and flowers	Tea, Decoction	Its flower's decoction is used as, diuretic, laxative and purgative to get rid of constipation. Roots extract is used for kidney diseases. Flowers and leaf boiled and their tea is flu, cold, cough and lung troubles.
46	Vitex negundo L.	Verben- aceae	Banaa (small tree)	Indigo Bush	MUH- 1735	Kadorah (Bhimber)	Fruit and Leaves	Extract, Paste, Tea	Its leaves are used as analgesic and anti-inflammatory. Leaf decoction is used for cure of eye infections and pain. Leaf paste is applied on scorpion and snake sting. Fruit and leaf boiled extract is used for curing chest pains.
47	Withania somnifera (L.) Dunal	Solan- aceae	Panee- rdodi (shrub)	Winter cherry	MUH- 1689	(Jatlan)	Fruit, root and leaf.	Poultice, tea, extract	Leaf poultices are used to treat cuts, wounds, inflammation and rheumatism. Its fruit decoction is used in anxiety and neurodegenerative disorders. It is used for vital body vigour. Its leaf is cooked and used in joint pains as poultice. Its root extract is used in cure of liver disorders. Fruit is used as aphrodisiac and astringent.
48	Zantho- xylum alatum Roxb.	Rut- aceae	Timber (shrub)	Prickly Ash	MUH- 1661	Bhimber (Samahni/ Bindi)	Fruit, Leaf, bark	Powder, Sauce, Extract	It is bitter, hot, irritating and is appetizer, used in asthma also useful in eye and ear troubles. Fruit's sauce is used as carminative and cure of flatulence in stomach. Its powder is also used for cure of fever, indigestion and dyspepsia.
49	Zizyphus jujuba Lam.	Rhamn- aceae		Jand (tree)	MUH- 1633	(Chowki)	Root, bark leaves, fruits and seeds	Extract, Powder	It is used in insomnia and hysteria. Fruits and leaves are useful to treat diabetes. The fruit is blood purifier and brings cooling sensations in the body. It tenders the blood, clear by removing waste matters from blood in all age groups.

Zizyphus numm- 50 ularia (Burm.f. Wight & Arn.	Rhamn-) aceae	Bair (tree)	Wild Jujube	MUH- 1633 MUH- 1622	(Jatalan)	Fruit and Leaves	Fruit, extract, Decoc-tion	Its fruit is used in insomnia and hysteria. Fruits and leaves are useful to treat diabetes. The fruit is blood purifier and brings cooling sensations in the body. It tenders the blood, clear by removing waste matters from blood in all age groups. It is also to cure cuts and wounds. It is aphrodisiac and cough reliever.
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4. CONCLUSIONS

Plants are important for the survival of human beings, animals and other living organisms. The human beings depend upon plants for fuel, medicines, forage, food, material for making agricultural tools and wood for construction. This research's findings depict that there is strong correlation between culture, area of habitance and herbal medicines use. It was found that albeit migrants of Bradford live in advanced country-UK, still use botanic and folklore medicines brought from their Pakistan-hometown. It was also found that older people have more knowledge of MPs and use them in their daily life to cure different diseases. There is trend of folklore or traditional knowledge erosion with passage of time and it is directly proportional to aboriginal culture and age. There is need to conduct further research to have rationale use of MPs or botanic drugs without or least side effects by doing drug dose optimization. This TEMs can be used to explore pharmaceutical potential for drug discovery and drug development through optimization process. There is trend of loss MPs biodiversity that is due to several causes such as:

- i. extension of farm/agriculture by clearing of forests
- ii. deliberate cuttings of the trees for fuel needs
- iii. other factors are deforestation such as mass infrastructure construction
- iv. soil erosion
- v. grazing
- vi. fire.

5. GENERAL PERSPECTIVES AND FUTURE RECOMMENDATIONS

Plants play vital role in air purification, precipitation and moderate the temperature. But now a day, major parts of the area looks barren. There is huge gap between plantation and demand of tree for few land construction survey of the area showed that there is no proper system of plantation and protection of plants. Some recommendations for concerned departments and local communities are as:

✓ to protect forest from fires that is generally caused due to human negligence and its own action which destroys cultivated and wild forest plants and wild life,

✓ to reduce or control incessant grazing by domestic animals which reduces forest productivity and land cover leading toward soil erosion,

✓ to control cutting of trees or plants for fuel purpose and for this alternative LPGs may introduced at low or subsidized prices,

✓ to provide proper guidance and training to Hakims and local people in collection of medicinal plants, if not then whole plant or its seeds will be lost, with no future plant outcome on the land,

 \checkmark to set up natural conservation nursery and protected areas for MPs and other commercial plants of the area,

 ✓ to involve public-private joint-venture to protect the wild forest of the area, with provision of some remuneration or other botanic barter trade for their easy participation,

✓ to do afforestation and reforestation planned activities in the area by free plants provision to the local people and forest department may introduce the threatened plants in the area at public level for their sustainable availability in the area and

✓ to do compile ethnomedicinal and traditional cultural data of local and migrants people of Bhimber to UK for their comparison and historic perspectives and induce the mechanism to mitigate the erosion of biocultural and phytotherapeutic knowledge in coming generations.

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Prof. Dr. M. Ajmal Khan (1953–2019)

Vice President, Pakistan Academy of Sciences, (PAS)

&

Vice Chancellor, University of Karachi, Karachi

Prof. Dr. M. Ajmal Khan a versatile Botanist of Pakistan, Vice President, Pakistan Academy of Sciences and Vice Chancellor, University of Karachi, Karachi breathed his last on May 04, 2019 at Karachi. As one of the most highly rewarded academician and scientist of Pakistan, Prof. Dr. M. Ajmal Khan has left behind a rich harvest of sweet memories and achievements as inspiration for all those who know him.

Prof. Dr. M. Ajmal Khan joined Pakistan Academy of Sciences as Fellow in 2001. He served the Academy as Secretary: PAS Karachi Chapter from 2004-2007 as well as Vice President, PAS from 2018- May 2019.

Prof. Dr. Ajmal Khan had a distinguished career in the field of Botany. His specific research interests included Seed Dormancy, Salt Tolerance, Demography of Salt Marsh and Salt Desert Species and Evaluation of Cash-crop Halophytes. In recognition of his outstanding contributions in the field of Botany, Ecological Management of Intertidal, Coastal and Inland Saline Ecosystems. Prof. Dr. M. Ajmal received prestigious civil awards, including: Sitara-i-Imtiaz (2007) and Presidential Award of Pride of Performance, (2001). His others awards include Life Time Achievement Award by Pakistan Botanical Society, 2016; Distinguished Scientist of the Year, Pakistan Academy of Sciences, 2008; Gold Medal, Pakistan Academy of Sciences, 1999; 1st Position in M.Sc., University of Karachi, Pakistan.

Prof. Dr. M. Ajmal Khan was also honored with membership of various outstanding national and



international bodies, including The Islamic World Academy of Sciences (IAS), The World Academy of Sciences (TWAS), Fulbright Research Fellowship, German Academy Exchange Services (DAAD), Germany, Member: Botanical Society of America, International Ecological Society (INTECOL), Life Member, Pakistan Botanical Society, Sigma Xi, USA; National Curriculum Committee, University Grants Commission.

Throughout his scientific career, Prof. Dr. M. Ajmal Khan remained a strong source of encouragement and support for his students and associated scientific community. There are no words to describe how much he will be missed. Our thoughts and heartfelt condolences go out to the family, friends and colleagues.

May ALLAH Almighty bless his soul in peace in heaven; Aameen.

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Obituary

Engr. Dr. M. Yousaf Hasan Bangash (1932–2019)

Foreign Fellow, Pakistan Academy of Sciences

Engr. Dr. M. Yousaf Hasan Bangash, a Foreign Fellow of the Pakistan Academy of Sciences breathed his last on June 10, 2019 in London, UK. While working abroad as one of the most highly rewarded and versatile engineer of Pakistan, Dr. Yousaf Hasan Bangash has left behind a rich harvest of memories and professional achievements as inspiration for all those who know him.

Dr. Bangash was born in British India on April 1st, 1932. He received his B.Sc. and B.Sc. Engg. Degree from University of Peshawar in 1953, M.Sc. Engg. Degree from California Institute of respectively. He was well recognized for his distinguished contributions in the field of Aerospace Engineering, Software Development in Engineering Sciences, Explosion Dynamics. In recognition of his outstanding contributions, he received eleven Gold Medals including the 1999 Dr. F. L. Rahmam Medal from Chicago Consultants Inc.

Throughout his professional career, Dr. Bangash held important positions including Defense Consultant, Aerospace-Naval Structures, UK Defense Department, London, 1991-1993; Professor of Aerospace Structures, Middlesex University, London, 1980-91; Group Consulting Engineer, Atomic Power Construction Ltd., Surrey, 1973-80; Consultant UKAEA, 1966; Consultant, Nuclear Aerospace Structures, British Aerospace, Surrey, 1966-1969; Reader, Aerospace Structures, Imperial College, London, 1966-73; Senior Lecturer, Aerospace Structures, University of Greenwich, London, 1963-65; Senior Manager, Nuclear Construction, General Atomic Inc., San Diego, California. 1962-64; Senior Group Engineer, Lockheed International Inc., California, 1960-1962; Senior Lecturer in Structural Engineering,



College of Engineering, University of Peshawar, 1957-59; Structural Design Engineer, US Core of Engineers, Kharian, 1954-56.

Dr. Bangash was also honored with membership of various outstanding bodies, including FeACE, Struct. E. of UK; Member: Nuclear Inst., British Standards (BSI) and International Standards (ISO); Cited in American WHO's WHO, New York and in Federal Emergency Agency (FEMA) Report, Washington, D.C.; Structural Board of American Institute of Aeronautics and Astronautics, 2004; Governor of the Union of Muslim Organizations (UMD), UK.

Dr. M. Yousaf Hasan Bangash will always be missed by all the Academy Fellows. Our thoughts and heartfelt condolences go out to the family, friends and colleagues.

May ALLAH Almight bless his soul in peace in heaven; Aameen.

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Manuscripts, in *Times New Roman*, 1.5-spaced (but single-space the Tables), with line numbering and one-inch margins on all sides on A-4 size paper, should not exceed 20 pages including Tables and Figures. Number manuscript pages throughout. The text (in **Font Size 11**, except for the sections mentioned in **Font Size 10**) must be typed in a single column across the paper width. All Tables and Figures must be placed after the text, i.e., after REFERENCES section.

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- 2. Bialek, W. & S. Setayeshgar. Cooperative sensitivity and noise in biochemical signaling. *Physical Review Letters* 100: 258–263 (2008).
- 3. Kay, R.R. & C.R.L. Thompson. Forming patterns in development without morphogen gradients: differentiation and sorting. *Cold Spring Harbor Perspectives in Biology* 1: doi: 10.1101/cshperspect.a001503 (2009).

b. Books

- 4. Luellen, W.R. Fine-Tuning Your Writing. Wise Owl Publishing Company, Madison, WI, USA (2001).
- 5. Alon, U. & D.N. Wegner (Ed.). An Introduction to Systems Biology: Design Principles of Biological Circuits. Chapman & Hall/CRC, Boca Raton, FL, USA (2006).

c. Book Chapters

- Sarnthein, M.S. & J.D. Stanford. Basal sauropodomorpha: historical and recent phylogenetic developments. In: *The Northern North Atlantic: A Changing Environment*. Schafer, P.R. & W. Schluter (Ed.), Springer, Berlin, Germany, p. 365–410 (2000).
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