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Essential Minerals Content in the Ethnozoological Products Used in the Folklore Medicines by the Tangkhul Tribe of Manipur, India

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ABSTRACT:
Background: Manipur lies in the north-eastern region of India under the Indo-Burma biodiversity hotspot having a rich variety of flora and fauna. Tangkhul tribes are main habitant of the Ukhrul district of Manipur and popular for using the products of animal fauna as traditional medicines for curing many human diseases. No study has been carried out so far on the essential minerals level of the ethnozoological products used in the traditional medicines by the Tangkhul Naga tribe of Manipur. The objective of the study is to determine the essential minerals content in the thirteen (13) selected ethno zoological products namely, *Periplaneta americana, Pheretima pusthusma, Heterometrus bengalenesis, Cybister tripunctatus, Sclopendra gigantea, Hoplobatrachus tigerinus, Tylototriton verrucosus, Python molurus(Skin part), Python molurus(fat portion), Upupa epops, Cervus unicolor, Sus domesticus, and Melursus ursinus* and correlate with their uses in the indigenous folklore medicines by the Tangkhul Naga tribe of Manipur. Ethnozoological products were collected using semi-structural questionnaires from the local medicinal practitioners as well as from the old men and women. Essential major and minor minerals content were evaluated for the first time using ICP-OES (Inductively Coupled Plasma Optical Emission Spectrometry)**,** one of the most powerful techniques for its quick multi elemental analysis capability and high sensitivity to detect and characterize the minerals. The result of the study revealed that four major minerals namely Calcium (Ca), Potassium (K), Sulphur (S) and Magnesium (Mg) and trace minerals like Iron (Fe), Zinc (Zn), Copper (Cu), Manganese (Mn), Cobalt (Co), Selenium (Se) and Vanadium (V) detected in mg/Kg unit were present in varying concentrations in the ethno-zoological products with high and notable concentration of Ca, K, Fe and Zn. The results of the present study support the therapeutic usage of these ethnozoological products in the folklore practices for curing various human diseases by Tangkhul Naga Community of Manipur.

Introduction:
Minerals are needed in minute's quantities in a number of life processes in the body and are intimately involved in the number of physiological functions of the entire human organ. Some minerals play a very important role in the formation of active chemical components present in biological products and therefore contributed to their medicinal effects. Therapeutic usages of biological products including animal products in curing various diseases due to presence of metallic minerals are now a recent approach in medicinal field. Most of the ethnozoological products are found to be high in content in one or more individual minerals thereby providing a possible link to the therapeutic action of the medicines. The human body requires a number of minerals in order to keep a good health [1]. It has been reported that for the treatment of certain ailments and strengthening the immunity, the human body needed a small amount of minerals, which defend our body from the harmful infectious agents or make it to recover from serious infection. Major minerals like potassium (K), sulphur(S), calcium (Ca), magnesium (Mg) and trace minerals like iron (Fe), zinc (Zn), copper (Cu), cobalt (Co), and vanadium (V) are essential micronutrients involved in many physiological processes [2-3] and are reported to involve in various enzymatic functions and

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immunologic activities [4-5]. It is also well understood that certain trace minerals are essential for the healthy growth and the uptake of some essential minerals can also enhance therapeutic potential in some cases. So, the content of various macro and trace minerals are important to determine effective and scientific validation of therapeutic uses of these ethnozoological products. Further, as certain minerals at the higher levels are hazard to human body, such evaluation would be helpful in regulating their uses.

In recent years, researchers' interest in the role of minerals in biological systems has increased. Almost every metabolic process operates by involving trace elements, ultra-trace elements or minerals making them essential for human metabolism, biochemical and metabolic interactions and are very relevant to human medicine [5]. Especially for trace elements such as Se, Fe, Zn and Cu but also for minerals such as Na, K, Ca and Mg and other specific binding and transport proteins could be identified in different membranes of cells, intracellular and in body fluids [6]. K and Ca plays a key role in a variety of nerve and muscle functions, Mg is found in a variety of enzymes and cells such as muscle cells while Zn in turn is also found in enzymes, catalyzing many synthetic biological. Fe is a trace mineral with an essential role in oxygen transportation e.g., in hemoglobin of erythrocytes. In addition, two of the most important trace minerals playing a major role in the development of oxidative stress are Se and Cu. They are mandatory to numerous *oxidase* and superoxide dismutase (SOD) reactions in the cytosol especially Cu is a critical functional component of a number of enzymes related to oxidative stress e.g. SOD, cytochrome C oxidase (CCO) in the mitochondria and tyrosinase [7].

Moreover, minerals are widely used in medicinal, pharmaceutical, agricultural and chemical industries. Recent report indicates the attention to the chemistry of minerals and their clinical applications for the treatment of various disorders including communicable and non-communicable diseases. Accordingly, research interest has shifted toward the search of natural source of minerals and their biological activities such as antioxidant and antimicrobial activities. In the past few decades, studies have revealed that minerals such as Cu, Cr, Co, Mn, V and Zn have promising antimicrobial, anti-oxidant, anti-tumor and anti-diabetic properties. The issues of mineral-based therapy have witnessed increasing focus with respect to efficient strategies in the design of slow-release, or long-acting drugs. In this regard, minerals are important classes of biologically active molecules that have attracted attention of bioinorganic, pharmaceutical and medicinal chemists due to the wide range of pharmacological properties [8-9].

Since the last many years, abundant research works have been undergone on the organic constituents of the biological products used in the traditional medicines while there is lack of attention on the role of inorganic minerals in the traditional medicines and their therapeutic uses against human diseases. Traditional medicines have been practiced since man became a culture animal, however studies on animal-based traditional medicines have been comparatively low compared to plants based traditional medicines. Therefore, it is important to record such information and knowledge on traditional medicines based on animal fauna by the indigenous communities before it gets lost forever [6]. Tribal populations of north east states of India have rich knowledge of the uses of high-quality digestible protein and minerals with antibacterial which may be useful for preventing oxidative related inflammation and mucosal damage [4]. Tangkhul Naga tribe are the main inhabitant of the Ukhrul district of Manipur which is rich in biodiversity as the state is located at the confluence of Eastern Himalaya and Indo-Burma biodiversity hotspots. Tangkhul inhabited areas of Ukhrul district is the home to many endemic and endangered flora and fauna. The native of this district is quite popular for their folklore practices of using ethnozoological products in the treatment of various human diseases since time immemorial [10]. However, to our knowledge, no studies have been done and there is non-existent of literature regarding the mineral contents in these ethnzoological products used in folklore medicines by this tribal community. As the minerals are one of the detrimental chemicals in our body and playing important roles in human health, minerals content in the ethno zoological products used by the Tangkhul Naga tribe of Manipur in the traditional medicines were analyzed for the first time using ICP-OES (Inductively Coupled Plasma Optical Emission Spectrometry), one of the most powerful techniques for its quick multi elemental trace analysis capability and high sensitivity was used to detect and characterized the elements. The result of the study is given in this communication.

Materials and Methods:

Study Area: Manipur is a hill state in the North-eastern region of India and lies between 23.5^0N and 25.4^0N and between 93.4^0E and 94.3^0E. The state shared its border with Nagaland on the north, Mizoram and Myanmar on the south, the Somra tract and upper Chindwin District of Myanmar on the east and Cachar District of Assam on the west. The total area of the state is of 22,327sq.km with an altitude ranging between 1,500 to 3,000 m above the mean sea level (amsl). Ukhrul District where Tangkhul community are the main inhabitants is located at the north-eastern part of Manipur bounded by Myanmar in the east, Nagaland state in the North,

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Imphal east and Chandel District of Manipur in the south and Senapati and Kangpokpi District in the west (Figure-1, Blue colour). The geographical coordinates of the district are at 24ºN - 25.41ºN and 94ºE- 94.47ºE. The district is hilly in terrain with varying heights of 913 to 3114m amsl [11]. The climate of the district is pleasant during most part of the year with temperature ranging from 3ºC to 33ºC with an average annual rainfall about 85.32cm.

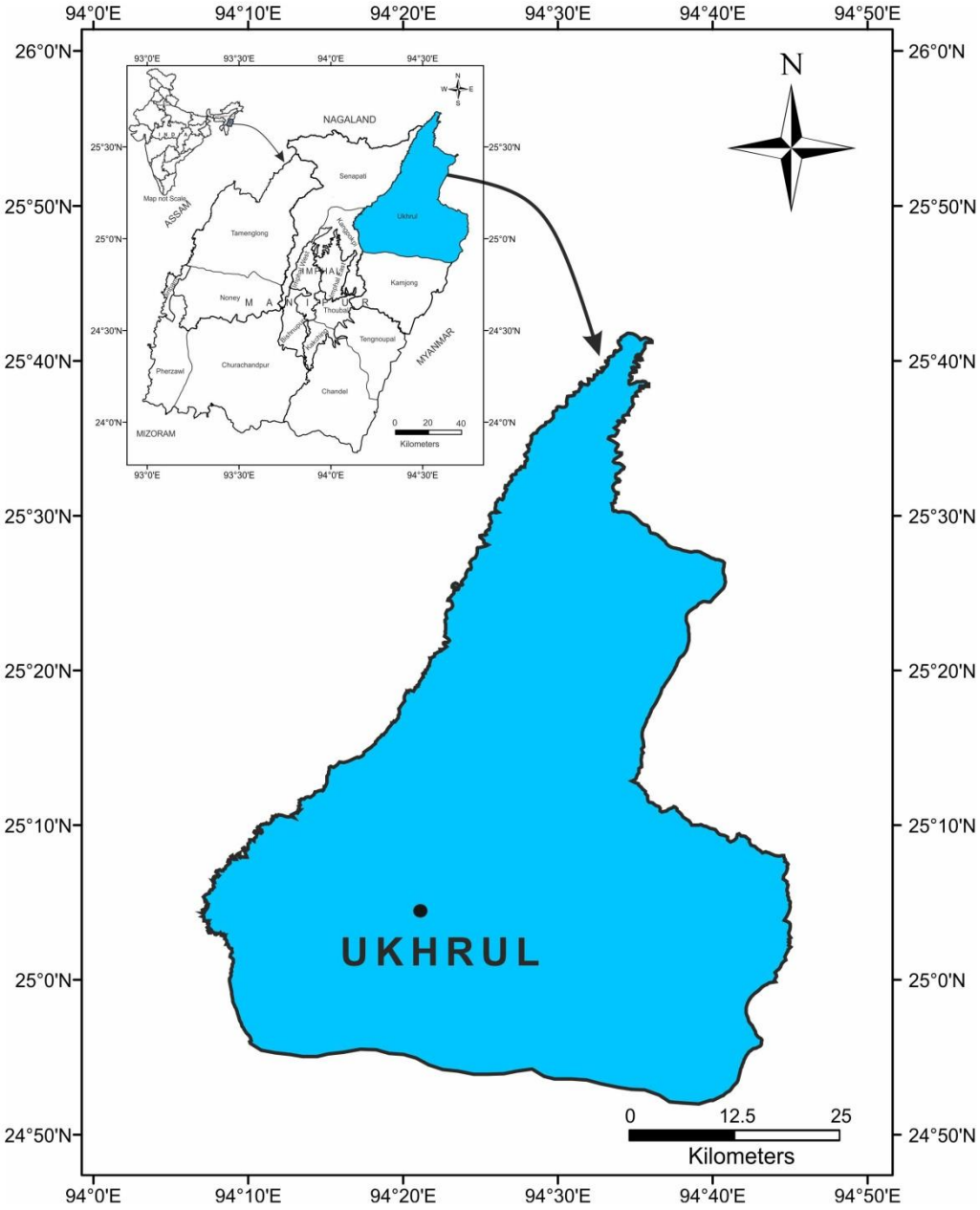

Figure 1: Indian map showing Ukhrul district of Manipur State

Data Collection:

A survey was conducted for a period of one year from the March 2021 to March, 2022 and data were collected through semi-structural questionnaires administered to the local indigenous people, interaction with local medicinal practitioners as well as old men and women through oral conversations. The collected information was about the various traditional knowledge regarding the use of animals and their products. Most of the data recorded is based on verbal communication with the local people. All the animal species used in the traditional medicinal practices were identified by using

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relevant & standard literature. Ethnozoological products collected were of *Periplaneta americana, Pheretima pusthusma, Heterometrus bengalenesis, Cybister tripunctatus, Sclopendra gigantea, Hoplobatrachus tigerinus, Tylototriton verrucosus, Python molurus(Skin part), Python molurus(fat portion), Upupa epops, Cervus unicolor, Sus domesticus, and Melursus ursinus* (Figure-2).The local people were asked simple questions during interaction like the various animals and animal products used for treatment of various human ailments and any other local folklore which is considered important with the animal in questions. When the whole animal body parts or its products were used, the specimen was shown to us by interviewee and from the pictorial illustrations, we are able to identify the species in question [12-13]. When some species of animals belongs to a protected species, we could not collect specimen samples, however, we collected local name and common name.

ICP-OES Analysis:

Instrumentation: Essential minerals analysis in the ethnozoological products were carried out at Sophisticated Analytical Instrumentation Facility (SAIF), North Eastern Hill University (NEHU) Shillong, Meghalaya, India using an iCAP 7600 Inductively Coupled Plasma Optical Emission spectrometer (model: Thermo Scientific TM IcapTM 7600). The instrumental operating parameters used in the ICP-OES system include a wavelength range of 166 to 847 nm, nebulizer gas with 0-2L/min mass flow control, and auxiliary gas with 0-2L/min mass flow control.

Pre-treatment of samples: Before minerals analysis, oven-dried powder samples were weighed in a laboratory weighing machine, and 0.5 g of the sample was added to a 150 ml borosilicate glass beaker filled with 10 ml of concentrated HNO_3. The beakers were covered using a Petri plate of suitable size, and the reaction mixtures were heated on a hot plate at 85ºC for 3 hrs. After the samples were cooled, 5 ml of 30% (v/v) H_2O_2 was added, and heating continued for about 30 minutes until the solution appeared clear, and the volume reduced to approximately 2 ml. Finally, the remaining aliquots were transferred into a 25ml centrifuge tube, and the volume was made up of de-ionized water, followed by the mineral analysis by ICP-OES.

Statistical Analysis: Experiments were performed in triplicates, and the experimental data were analyzed using SPSS version. 20 and were expressed as mean ± SEM.

Table 1: Uses of Ethnozoological Products in traditional medicines by Tangkhul Naga Tribe of Manipur, India

Sl. No	English Name	Taxonomic Name	Local Name	Parts of animal Used	Therapeutic Uses
1.	Bear	*Melursus ursinus*	*Saingom*	Gall Bladder	A teaspoonful of honey in hot water is mixed with pieces of gall bladder and stir until completely dissolved and use in the treatment of the pain reliever.
2.	Pig	*Sus domesticus*	*Hok*	Meat	Child bearing women and lactating mothers were administered with boiled fermented pork for good health and protection from anaemia.
3.	Hoopoe	*Upupa epops*	*Kajeihar*	Meat and Bone	Health problems such as kidney stone cases, urinating problem and white discharge in women were treated with soup of boiled meat and bone twice a day.
4.	Python	*Python molurus*	*Rarei*	Fat portion	Python fat is applied to relieve body ache, rheumatic, and burn wounds pain.
5.	Python	*Python molurus*	*Rarei*	Skin part	Treatment of epilepsy, high fever
6.	Salamander	*Tylototriton verrucosus*	*Lengba*	Whole body	Whole body of salamander is roasted and consumed with salts at least once a week for the treatment of cancer.
7.	Frog		*Khaifa*		Boiled soup of the flesh part of the hindlegs of frog is administered to

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		Hoplobatrachus tigerinus		Flesh portion of Hindleg	keep healthy and for the treatment of cough.
8.	Centipede	*Scolopendra gigantea*	*Katei nakhui*	Whole body	Wine prepared after keeping centipede for few hours is mixed with its secretion and then prescribed one glass of mixture twice a day for treatment of tuberculosis.
9.	Cybister	*Cybister tripunctatus*	*Gazikla*	Larvae	The cocktail prepared from the larvae of Cybister with water and honey is consumed twice a day for the treatment of small pox, allergy and cough.
10.	Scorpion	*Heterometrus bengalensis*	*Seithak*	Whole body	A whole body of scorpion is placed in boiled water or wine for one or two hours and drinks the water for about one glass of water twice a day after filtration. It is also consumed after roasted for the treatment of cancer.
11.	Cockroach	*Periplaneta americana*	*Pharao*	Whole body	Whole body of the cockroach is consumed after roasted for the treatment to reduce sugar level in the patients with diabetes mellitus
12.	Earthworm	*Pheretima posthuma*	*Lingdak*	Whole body	Whole body part of the earthworm is crushed in water and drink for about 10 ml thrice a day for the treatment of typhoid, as antidote in snake and spider bites and also for curing burning sensation during skin injury.
13.	Deer	*Cervus unicolor*	*Chao*	Bone marrow	Ointment prepared from the deer bone marrow is apply for the treatment of pain in joints from arthritis also for burn and sprain.

Periplaneta americana

Pheretima posthuma

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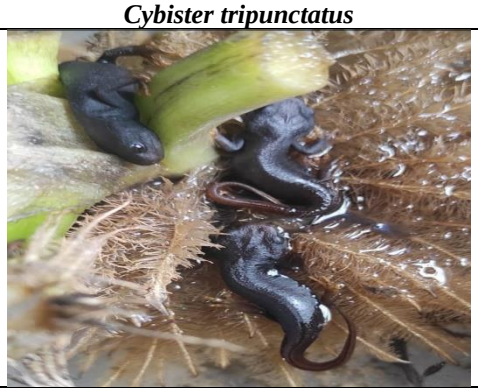
Heterometrus bengalensis	***Hoplobatrachus tigerinus***
	
Cybister tripunctatus	***Upupa epops***
	
Tylototriton verrucosus	***Cervus unicolar* (Bone marrow)**
	
Python molurus (Skin)	***Python molurus* (fat)**

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***Melursus ursinus* (Gall bladder)**

***Sus scrofa* (Fermented pork)**

***Scolopendra gigantea* (Large)**

***Scolopendra gigantea* (Small)**

Figure-2. Ethnozoological products/species used by Tangkhul Naga tribe of Manipur in their folklore medicines

Table 1. Concentration of essential major minerals (mg/kg) in the selected ethnozoological products used in traditional medicines by Tangkhul Naga Tribe of Manipur. Values are mean ± SEM, 3 observations each.

Sl.No.	Scientific Name	Ca	K	S	Mg
1.	*Periplaneta americana*	23.9 ± 3.37	55.74 ± 5. 54	14.78 ± 2.152	3.97 ± 0.032
2.	*Pheretima pusthuma*	14.6 ± 2.14	45.3 ± 5. 91	23.43 ± 3. 27	3.06 ± 0.901
3.	*Heterometrus bengalensis*	24.9 ± 2. 29	42.92 ± 1. 33	38.34 ± 5. 50	2.86 ± 0.048
4.	*Cybister tripunctatus*	5.20 ± 1. 11	54.8 ± 6. 79	10.0 ± 2. 27	4.25 ± 0.047
5.	*Scolopendra gigantea*	7.50 ± 2. 12	44.9 ± 8. 72	24.7 ± 4. 52	1.94 ± 0.039
6.	*Hoplobatrachus tigerinus*	151.4 ± 6.75	63.5 ± 4.92	20.5 ± 2.48	4.64 ± 0.042
7.	*Tylototriton verrucosus*	138.6 ± 10.25	49.15 ± 0.632	22.9 ± 3.48	3.36 ± 0.019
8.	*Python molurus(skin part)*	6.58 ± 2.28	37.5 ± 4.69	12.9 ± 2.37	0.89 ± 0.003
9.	*Python molurus(fat portion)*	14.5 ± 3.27	4.64 ± 1.12	2.19 ± 0.273	0.71 ± 0.005
10.	*Upupa epops*	139.8 ± 3.615	50.9 ± 6.82	27.3 ± 5.60	3.48 ± 1.022
11.	*Cervus unicolor*	88.22 ± 1.573	4.42 ± 1.11	2.01 ± 0.079	1.86 ± 0.028

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12.	*Sus domesticus*	2.19 ± 0.21	31.9 ± 5. 64	21.7 ± 4.42	1.55 ± 0.029
13.	*Melursus ursinus*	3.71 ± 1.10	6.78 ± 2.38	3.09 ± 0.149	0.50 ± 0.007

Table 2. Concentration of essential trace minerals (mg/kg) in the selected ethnozoological products used in traditional medicines by Tangkhul tribe of Manipur. Values are mean ± SEM, 3 observations each.

Sl.No.	Scientific Name	Fe	Zn	Mn	Cu	Co	V	Se
1.	*Periplaneta americana*	27.6 ± 3. 346	4.56 ± 1.15	0.180 ± 0.003	0.372 ± 0.007	0.102 ± 0.002	0.051 ± 0.003	06 ± 0.002
2.	*Pheretima pusthuma*	3.00 ± 0.421	1.68 ± 0.031	0.148 ± 0.007	0.029 ± 0.003	0.089 ± 0.001	0.188 ± 0.002	ND*
3.	*Heterometrus bengalensis*	8.62 ± 1.03	9.26 ± 1.074	1.453 ± 0.016	1.201 ± 0.038	ND*	ND*	03 ± 0.001
4.	*Cybister tripunctatus*	17.83 ± 1.36	1.36 ± 0.025	0.262 ± 0.011	0.254 ± 0.004	0.027 ± 0.0001	ND*	ND*
5.	*Scolopendra gigantea*	6.30 ± 0.53	4.74 ± 0.26	0.124 ± 0.004	0.131 ± 0.007	0.037± 0.001	0.201± 0.001	01 ± 0.001
6.	*Hoplobatrachus tigerinus*	12.34 ± 2.803	1.14 ± 0.025	0.258 ± 0.003	0.016 ± 0.005	0.018 ± 0.0002	ND*	ND*
7.	*Tylototriton verrucosus*	7. 615 ± 152	1.93 ± 0.317	0.215 ± 0.003	0.024 ± 0.006	0.009 ± 0.0002	0.357 ± 0.001	ND*
8.	*Python molurus (Skin part)*	3.00 ± 0.151	0.710± 0.005	0.050 ± 0.002	ND*	ND*	0.136 ± 0.004	ND*
9.	*Python molurus (Fat portion)*	7.414 ± 0.271	0.350 ± 0.007	0.114 ± 0.005	0.003 ± 0.0001	ND*	0.103 ± 0.003	ND*
10.	*Upupa epops*	9.26 ± 2.35	1.320 ± 0.052	0.246 ± 0.001	0.056 ± 0.001	ND*	0.133 ± 0.0001	ND*
11.	*Cervus unicolor*	4.53 ± 1.63	0.472 ± 0.057	0.081 ± 0.0001	0.006 ± 0.0001	ND*	ND*	ND*
12.	*Sus domesticus*	2.68 ± 0. 43	1.903 ± 0.038	0.013 ± 0.0001	0.003 ± 0.0001	ND*	0.394 ± 0.005	ND*
13.	*Melursus ursinus*	1.463 ± 0.052	0.232 ± 0.006	ND*	0.005 ± 0.0003	ND*	0.401 ± 0.002	ND*

*ND: Not detected

Results and Discussion:

Essential minerals concentration in ethnozoological products used by the Tangkhul tribe of Manipur in the medicinal practices was determined by using ICP-OES and results obtained were shown in Table no-1 and 2 while the photographs of different 13 selected animal products used/ species collected viz. *Periplaneta americana, Pheretima pusthusma, Heterometrus bengalenesis, Cybister tripunctatus, Sclopendra gigantea, Hoplobatrachus tigerinus, Tylototriton verrucosus, Python molurus (Skin part), Python molurus(fat portion), Upupa epops, Cervus unicolor, Sus domesticus, and Melursus ursinus* were shown in Figure number-2.

Analysis of data from the Table 1 and 2 revealed the presence of varied concentration of essential minerals in all the ethnozoological products studied. Among the major minerals, Ca is recorded in the highest content in the ranges between 2.019 ± 0.21 mg/Kg to 151.4 ± 6.75 mg/Kg with the highest value is found in *H. tigerinus* (Table-1). Ca is considered as an indispensable major mineral for the good bone and teeth health and generally helps in the proper contraction of heart muscles [7,9,14]. The concentration of K in the ethnozoological products ranges in between 4.46 ± 1.12 mg/Kg to 63.5 ± 4.92 mg/Kg with the highest notable amount recorded again in the *H. tigerinus*(Table-1). K is a vital mineral for proper functioning of the neurons in the brain thereby preventing stroke. It plays an important role in acids-base balance and regulation of fluid in the tissues and blood and thus help in maintaining blood pressure in our body [7,15-16]. In the present study, the highest content of the S was recorded in *H. bengalensis* among the different ethnozoological products studied while the recorded ranges of S is from the 2.01 ± 0.079 mg/Kg to 38.34 ±5.50 mg/Kg (Table-1). S is an essential mineral for the formation of vitamin B_1 for healthy hair, skin and nails [3]. The concentration ranges of the Mg in the ethnozoological products studied in our study is in between 0.71 ± 0.005 mg/Kg to 4.64 ± 0.042 mg/Kg with notable amount of Mg recorded in *H. tigerinus* while compared to other ethnozoological products studied. Mg is considered an important mineral which play a vital role in the mineralization of bone, relaxation of muscles and other vital cellular functions. Deficiency of Mg in the body may resulted risk in sugar metabolism, risk of hypertension, osteoporosis risk and risk of stroke [17-20]. Due to various detrimental functions played by the Ca, K, S and Mg on the body important physiological functions for keeping the body in good health, the used of these ethnozoological products in the treatment of certain human ailments in the folklore medicines may be attributed to notable amount of Ca, K, S and Mg specially Ca, K present in them.

Table- 2 reveals wide variation in the trace minerals content of the different ethnozoological products studied. Analysis of the present data revealed that Fe was observed with the highest concentration in all the ethnozoological products studied as compared to other

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trace minerals recorded. The descending order of the concentration of the minerals in the ethnozoological products studied is Fe>Zn>Mn>Cu>Co>V>Se. The present data indicated that Fe was recorded with high concentration in all the ethnozoological products studied as compared to other trace minerals. The concentration of Fe was found highest in *Periplaneta americana* (27.684 ± 0.346 mg/Kg)(Table-2). Fe has various key functions in the human body including supply of oxygen, production of energy, immune defense against pathogen, an activator in the formation of various hormones and have an important role in the bacteria killing effect of lysozyme and lactoferrin [1, 21]. Due to positive roles play by the Fe on the body immunity, the used of these ethnozoological products in the treatment of certain human ailments in the folklore medicines may be attributed to high amount of Fe present in them.

Just like Fe, Zn is an essential trace mineral and acts as cofactor of various enzymes like *carbonic anhydrase* and is known to stimulate action of insulin. Zn is also required for various other functions of the body such as growth, clotting of blood and proper function of thyroid etc. Uptake of the excess amount of Zn more than the permissible limit may influence toxic effects on the body immune system [22-25]. The concentration of the Zn in the present study ranges from 0.232 ± 0.006mg/Kg to 9.26 ±1.07 mg/Kg with *H. bengalensis* containing the maximum content (Table- 2). In view the important role of Zn through the enzymes, growth and blood function etc. the indigenous used of these ethnozoological animal parts for prevention and management of certain human diseases may be attributed to the presence of appreciable amount of Zn in these products. We also observed that *P. americana* and *H. bengalensis* are eaten after being roasted by Tangkhul tribe of Manipur for the treatment of diseases like diabetes mellitus.

Cu is an essential in trace amount to the human body as it is a component of many enzymes of our body like *cytochrome oxidase*, *lysyl oxidase* and an iron oxidizing enzyme in blood like *ceruloplasmin.* Cu also helps in the proper utilization of Fe in the hemoglobin, therefore deficiency of Cu may result anemia [7,26]. As the Cu influence in the proper functioning of our immune system and also have anti-infectant potentials [1], the considerable amount of Cu in all the ethnozoological products studied further support their used in curing certain diseases by the medicinal practitioners of Tangkhul community of Manipur. In this study, varying concentration of Cu was observed in all the ethnozoological products samples studied with the range up to 1.201 ± 0.038 mg/kg with the highest content of Cu was found in the *Heterometrus bengalensis* while Cu cannot be detected in some ethnozoological products studied (Table- 2).

Further, Mn, Co, V and Se were also detected in the 13 ethnozoological products in varying concentrations with the highest content of Mn, Co, V and Se were observed in *Cybister tripunctatus* (0.262 ± 0.011mg/Kg), *Periplaneta americana* (0.102 ± 0.002 mg/Kg), *Melursus ursinus* (0.401± 0.002 mg/Kg) and *Periplaneta americana* (0.006 ± 0.002 mg/Kg) respectively. Co is essential mineral in human health as it is an important component of Cobalamin (vitamin B_{12}) and its deficiency may result in the decrease in the RBC production in the body for fast transport of oxygen to injured cells [27]. Mn is also an essential trace mineral and acts as important cofactor of the enzymes of antioxidant defense system like Zn, Cu and Fe and also helps in the functioning of immune defense of the body by the amino acids breakdown, energy production system through the regularization of metabolism of vitamins and for proper digestion and assimilation of food [1,7,28]. The V plays an important role in the treatment of diabetes mellitus as it helps in the modulation of insulin signaling and also play an important role in the defense system from tissues injuries [1,29]. Like other essential minerals Se helps in various proteins functions along with vitamin E and low amount of Se in our body may result early aging, cataract and in the pathophysiology of oxidative stress in our body [30-31]. Thus, the essential trace minerals like Fe, Zn, Cu and Mn in addition to Co, V and Se are responsible for the various physiological roles including proper functioning of the immune system for defense from pathogen and recovering quickly from the infections [1], and as observe in this study, all the trace essential elements studied above were found to be recorded with appreciable quantity in all the 13 ethnozoological products used by the Tangkhul community of Manipur in its indigenous folklore medicines for the treatment of various human ailments. For the very first time, the data of the study justify the usage of these ethnozoological products in the indigenous folklore practices for the treatment and the management of the certain human ailments by the Tankhul Naga tribe of Manipur as they are recorded with notable amount of essential major and minor minerals such as Ca, K, S, Fe, Zn, Cu, Mn, V, S and Co. The data from this study can be used to determine a new dose for prescribing such animal-based medicines in order to integrate their medicinal properties in the new modern system of disease treatments. In addition to that, more in depth and comprehensive research need to undergone in this ethnozoological products to find out other bioactive compounds that can be an interesting chemical candidate for a new potential drug having biological values.

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