NUTRITIONAL VALUES AND CHEMICAL CONSTITUENTS OF QUILLS OF *HYSTRIX BRACHYURA* (LINNAEUS, 1758) USED IN TRADITIONAL MEDICINE IN MYANMAR

Thein Gi Naing[1] and Khin Mya Mya[2]

Abstract

Quills of *Hystrix brachyura* which are commonly used in Myanmar Traditional Medicinal system were selected for chemical and pharmacological investigation. Powder of quills of *Hystrix brachyura* were tested for the presence of macroelements, microelements, toxic elements and proximate analysis were also determined. Chemical analysis revealed the presence of calcium 2.75±0.4%, magnesium 0.34±0%, in the *Hystrix brachyura* respectively. Proximate analysis showed that *Hystrix brachyura* contained moisture 7.92±0.28%, ash 0.4±0.02%, water soluble ash 99.8±0%, acid insoluble ash 0.4±0%, protein 92.65±2.53%, fat 0.22±0.20% and fiber 1.14±0.04% respectively. Proximate analysis showed protein content in the highest amount in quills of *Hystrix brachyura* and chemical analysis showed calcium in high quantity. The content of arsenic was found to contain below levels according to the WHO standard. Cadmium, lead and mercury were not found in these samples. Moreover, mineral and element contents were also examined with reasonable concentration in these animal parts. This finding indicated that these animal parts may be used safety in the traditional medicine. However, as these parts come of natural living assets, there is a need to consider synthetic materials as substitute since in the long run, might impose a threat to these living assets.

Keywords: *Microelements, Macroelements, Toxic Elements and Proximate Analysis*

Introduction

Most of Myanmar traditional drugs are derived from sources of plants and animals. Wild and domestic animals and their by-products (e.g., hooves, skins, bones, feathers, milk and tusks) are important ingredients in the preparation of curative, protective and preventive medicine in Myanmar Traditional Medicine. According to the World Health Organization (1993), about 80% of the world people rely primarily on animal and plant-based medicines. About 20 % of Myanmar traditional medicine is based on animal-derived substances. Therefore these crude animal's products were selected for chemical and pharmacological investigation.

In Myanmar, quill of *Hystrix brachyura* also called Hpju Zu: which are commonly used in Myanmar Traditional Medicine formulation (TMF). Ash form of porcupines' quills is the ingredients of TMF-21(Hsi: Hsei: Phyu) and TMF-67 Pan:na chew:kja' pjau' Hsei:. Therefore in this research these crude animal's products were selected for chemical and pharmacological investigation.

The Malayan porcupine or Himalayan porcupine *Hystrix brachyura* is a species of rodent in the family Hystricidae. Three subspecies are extant in South and Southeast Asia (Woods and Kilpatrick, 2005).The Geographical distribution of Malayan porcupine ranges from Nepal through north-east India to Bangladesh, central and southern China, throughout Myanmar, Thailand, Lao PDR, Cambodia and Vietnam, through Peninsular Malaysia, to Singapore, Sumatra (Indonesia) and throughout Borneo (Azlan and Engkamat, 2006).

It is found in various types of forest habitats, as well as open areas near forests. It may stray into nearby agricultural areas. It digs into the ground and inhabits dens near rocky areas, where it lives in small groups. It has a gestation period of 110 days and a litter size of two or three. The species may give birth to two litters annually. Their habitat is terrestrial where they live in the hole

[1] Lecturer, Head of Department of Zoology, University of Traditional Medicine, Mandalay
[2] Dr, Professor (Retd), Head of Department of Zoology, University of Mandalay

of tree barks or roots. They also live in a burrow, from which a network of trails penetrate into surrounding habitat. They can be found in all forest types up to 1500m altitude (Parr, 2003).

Most porcupines are about 60-90 cm (25-36 in) long, with 20-25 cm (8-10 in) long tail. Weighing 5-16 kg (12-35 lb), they are rounded, large, and slow, and use aposematic strategy of defense. Porcupines occur in various shades of brown, gray, and white (Parker *et, al.,* 1990).

Porcupines' quills, or spines, take on various forms, depending on the species, but all are modified hairs coated with thick plates of keratin, and embedded in the skin musculature. Quills grow in varying lengths and colours, depending on the animal's age and species. Old World porcupines have quills embedded in clusters, whereas in New World porcupines, single quills are interspersed with bristles, under fur, and hair. The quills of New World porcupines are much smaller about 4 inches or 10 centimeters long and their end of each quill has a small barb. Quills are released by contact or may drop out when the porcupine shakes its body. New quills grow to replace lost ones (Attenborough, 2014).

There are some possible antibiotic properties within the quills, specifically associated with the free fatty acids coating the quills. The antibiotic properties are believed to aid a porcupine that has suffered from self-injury. Porcupines grow new quills to replace the ones they lose (David *et.al.,* 1990).

Porcupines are only occasionally eaten in Western culture, but are very popular in Southeast Asia, particularly Vietnam, where the prominent use of them as a food source has contributed to significant declines in their populations (Diana *et al.,* 2010*).*

The presence of barbs, acting like anchors, makes it more painful to remove a quill that has pierced the skin. The shape of the barbs helps makes the quills more effective both for penetrating the skin and remaining in place. The quills have inspired research for such applications as the design of hypodermic needles (Rijal *et, al.,* 2012).

Ash form of porcupines' quills was used by rulers of early Myanmar dynasties. Traditional medicine, As the In terms of Myanmar Traditional Medicine, porcupines' quills' taste is salty and cool in nature. The ash of porcupines' quills has been given analgesic and astringent property, sweet and cool in nature. It is also used in the treatment of cough, asthma, chest injuries, mouth disease, certain gastric and intestinal disorder, oliguria, hotness of urine, gonorrhea, piles, bowel disorder, blood vomiting and white discharge in Myanmar traditional medicine (Ashin Nagathein, 1975).

The medicinal fauna is largely based on wild animal’s part or whole, including some endangered species. After many years the natural sources such as animal’s species can be endangered. Synthetic materials need to be taken into consideration because the natural sources are living animals. Besides zoo therapeutic practices are being influenced on cultural aspects, the relations between humans and biodiversity. Thus in the present study, has been under taken with the following objectives:

- to identify the porcupines' quills of Myanmar that are used in Traditional Medicine
- to investigate the nutritional values and chemical constituents of porcupines' quills used in traditional medicine in Myanmar
- to assess their relevance in traditional medicinal practice

Materials and Methods

Study period

The study period lasted from July 2019 to February 2020.

Samples collection and identification

The quills of *H. brachyura* were purchased locally from Baja Hsei: zain (traditional medicine shop at Zay Cho Market, Mandalay) in July 2019. The collected specimens were brought to laboratory; Department of Zoology, University of Traditional Medicine, Mandalay and then color of specimens were immediately noted down and recorded with digital camera. These were specimens were preserved in drying place for later identification and measurement. A hand lens and dissecting microscope were used to observe these specimens. Identification was followed according to the Raha *et al*. (2015).

Samples preparation

The samples 150g quills of *H. brachyura* were first washed thoroughly with distilled water and then washed with sterile water mixed with 3c clime juice and next washed with sterile water to remove foreign matters and then sample is dried at drying condition in air oven. One hundred and fifty grams of samples were crushed into smaller pieces and then make powder by blender. The powder was sieved using a stainless steel sieve to get fine powder and then sterilized for an hour in the air oven at 105˚C and stored in bottles prior to analysis. Proximate analysis, mineral composition and pharmaceutical product were carried out on dried powder. The Proximate analysis were carried out according to the extraction is one of the procedure of Association of official analytical chemistry (A.O.A.C, 2000). Crude protein content was calculated using the Kjeldahl method 920.152 (2000). Crude fibre content was determined by the method 978.10 (2000) Fiber Cap Method. Lipid (fat) content was determined according to the Soxhlet method 960.39 (2000). Crude ash (inorganic matter) was determined according to method 942.05 (2000).

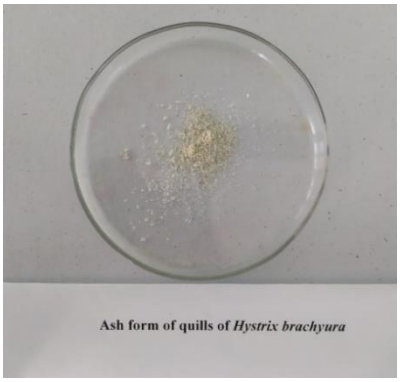
Determination of elements by energy dispersive X-ray Fluorescence Spectrophotometer(EDXRF)

The elemental analysis (macroelements, microelements, toxic elements) of the quills of *H. brachyura* powder were carried out at the SPECTRO X- Lab, at the Department of Geology, University of Mandalay and the M.G.A Petrochemical Lab Mandalay, Myanmar. The determination of elements of the powder of quills of *H. brachyura* was used by the FP- Pellets-121997ne1 method. X-ray fluorescence (XRF) play an important role in elemental analysis.An EDXRF system consists of several basic functional components: an X-ray excitation source, sample chamber, Si(Li) detector, signal processing and recording system .

Data entry and data analysis

Data entry and data analysis was used by Microsoft excel to compare element concentrations in percentages. The results were expressed as mean ± standard deviation (SD).

A. Powder form of quills *Hystrix brachyura*



B. Ash form of quills *Hystrix brachyura*

Plate 1 Preparation of powder and ash form of quills *Hystrix brachyuran*

Results

Systematic oosition of the studied species

Phylum	-	Chordata
Class	-	Mammalia
Order	-	Rodentia
Family	-	Hystricidae
Genus	-	*Hystrix*
Species	-	*H. brachyura* (Linnaeus, 1758)

1. Quills of *Hystrix brachyura*

Scientific name	-	*Hystrix brachyura*
Local name	-	Hpju Zu:
Common name	-	East Asian Porcupine

Each quill is marked with black and white bands. It can be up to 20 inches (51 centimeters) long. The quills of East Asian porcupine are smaller about 8 inches (20 centimeters) long and rigid (Plate 2).

According to the findings of this study on these samples, the highest amount of protein in quills of *Hystrix brachyura* were investigated in these samples (Table 1). The total ash, water soluble ash and acid insoluble ash involved in the powder of quills were shown in Table 2. The result for the mineral analysis indicates that calcium is the most abundant mineral present in these samples. Magnesium, sodium, chlorine, potassium and sulfur were detectable amount in these samples (Table 3). Manganese, aluminum, silicon, iron and zinc were also found in reasonable amount in the powder of quills of *Hystrix brachyura* (Table 4). The content of arsenic was found only in detectable amount and thus below level according to the WHO standard. Cadmium, mercury and lead were not found in these samples (Table 5).

Table 1 Proximate composition of the powder of quills of *Hystrix brachyura*

No	Parameters	Quantity 1 (%)	Quantity 2 (%)	Quantity 3 (%)	Quantity 4 (%)	Quantity 5 (%)	Mean ±SD (%)
1	Moisture	7.69	7.69	7.78	8.22	8.22	7.92±0.28
2	Ash	0.36	0.36	0.37	0.4	0.4	0.38±0.02
3	Carbohydrate	0	0	0	0	0	0±0.00
4	Protein	94.5	94.5	94.5	89.88	89.88	92.65±2.53
5	Fiber	1.11	1.11	1.11	1.18	1.18	1.14±0.04
6	Fat	0.37	0.37	0.37	0.00	0.00	0.22±0.20

Table 2 Total ash, Water soluble ash and Acid insoluble ash involved in the powder of quills of *Hystrix brachyura*

No.	Parameters	Quantity ((%)
1.	Total ash	0.4±0.02
2.	Water soluble	99.8±0
3.	Acid insoluble	0.4±0

Table 3 Percentage of macroelements involved in the powder of quills of *Hystrix brachyura*

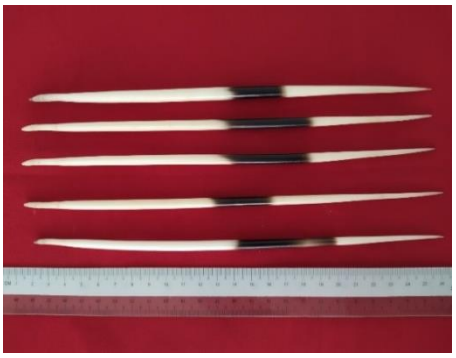
No	Elements	Quantity 1 (%)	Quantity 2 (%)	Quantity 3 (%)	Mean ±SD (%)
1.	Magnesium(Mg)	0.59	0.59	0.00	0.34±0
2.	Sodium (Na)	0.00	0.00	0.00	0.00±0
3.	Calcium (Ca)	2.98	2.98	2.29	2.75 ±0.4
4.	Chlorine (Cl)	0.00	0.00	8.36	1.54±4.83
5.	Potassium (K)	3.93	0.00	0.00	1.31±2.27
6.	Sulfur (S)	0.00	0.00	0.00	0.00±0

Table 4 Percentage of microelements involved in the powder of quills of *Hystrix brachyura*

No	Elements	Quantity 1 (%)	Quantity 2 (%)	Quantity 3 (%)	Mean ±SD (%)
1	Aluminium (Al)	0.00	0.00	0.00	0.00±0
2	Silicon (Si)	0.1	0.1	0.1	0.1±0
3	Manganese (Mn)	0.03	0.03	0.24	0.1±0.12
4	Iron (Fe)	0.002	0.002	0.22	1.33±1.99
5	Copper (Cu)	0.0003	0.0003	0.00	0.00 ±0
6	Zinc (Zn)	0.43	0.43	0.36	0.4±0.04

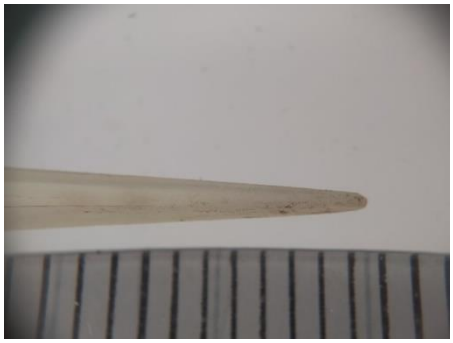
Table 5 Percentage of heavy metals involved in the powder of quills of *Hystrix brachyura*

No	Elements	Quantity 1 (%)	Quantity 2 (%)	Quantity 3 (%)	Mean±SD
1	Arsenic (As)	0.0008	0.0008	0.0001	0.0006±0.0004
2	Cadmium (Cd)	-	-	-	-
3	Mercury (Hg)	-	-	-	-
4	Lead (Pb)	-	-	-	-



A. Quills of *Hystrix brachyura*

B. Proximal end of quills of *Hystrix brachyura*



C. Distal end of quills of *Hystrix brachyura*

Plate 2 Quills of *Hystrix brachyura*

Discussion

The Proximate Composition of powder of quills of *Hystrix branchyura* revealed that these contained reasonable amounts of moisture, carbohydrate, fiber, protein and fat. Carbohydrate and fat contents were found to be very low in these samples. This confirms that sample is not a good source of fat. The contents of fiber were found to be considerable amount in these samples. Mixtures of soluble and insoluble fibers improve diabetic glucose control and lower serum triglycerides (Anderson, 1990). The content of protein was found to be highest in the powder of quills of *H. brachyura*. Protein provides essential amino acids, particularly important during growth and development, and it is a source of energy (Thomas *et al*., 2004). It is a reflection of total inorganic matter present in these samples and also indicates that these samples possess abundant minerals like calcium which are essential for good health (Oloyede, 2008).

The result for these minerals analysis revealed that the powder of quills of *H. brachyura* is a good source of macroelements. Especially calcium is the most abundant mineral present in these samples. The high content of calcium confirms its medicinal role in bone formation; calcium acts essential for the normal clotting of blood, by stimulating the release of thromboplastin from the blood platelets. Calcium is an activator for several key enzymes, including pancreatic lipase, acid phosphatase, cholinesterase, ATPases, and succinic dehydrogenase. Through its role in enzyme activation, calcium stimulates muscle contraction (i.e. promotes muscle tone and normal heart beat) and regulates the transmission of nerve impulses from one cell to another through its control over acetylcholine production. Calcium, in conjunction with phospholipids, plays a key role in the regulation of the permeability of cell membranes and consequently over the uptake of nutrients by the cell. Calcium is essential for the absorption of vitamin B12 from the gastro-intestinal tract (Reinhold, 1975).

Sodium and magnesium contents were examined detectable amount in these samples. Sodium is an extracellular cation involved in the regulation of plasma volume and acid- base balance, nerve and muscle contraction. Magnesium like calcium stimulates muscle and nerve irritability (contraction), regulation of intracellular acid-base balance, and it also plays an important role in carbohydrate, protein and lipid metabolism (Reinhold, 1975).

Potassium, chlorine and sulfur were found detectable amount in these samples. They serve a vital function in controlling osmotic pressures and acid-base equilibrium. Chlorine also plays a specific role in the transport of oxygen and carbon dioxide in the blood, and the maintenance of digestive juice pH. Sulfur is an essential component of several key amino acids. Sulfur involved in the detoxification of aromatic compounds within the animal body (Reinhold, 1975).

The presence of these essential minerals contributes to its medicinal values. The element concentration was expressed as part per billion (ppb). However, for the convenience of this study the results were also expressed in percentage. Aluminum, silicon, iron, zinc, manganese and copper were found in more reasonable amount in these samples. Zinc plays a vital role in lipid, protein, and carbohydrate metabolism. Iron plays crucial roles in haemopoiesis, control of infection and cell mediated immunity. Iron serves essential for oxygen and electron transport within the body (Reinhold, 1975).

Aluminum serves as antacids, astringents, buffered aspirin (Public health Statement, 2008). Silicon acts leukocyte activation, Coagulation and fibrinolysis cascades. It is not support microbiological growth (COLAS, 1995). The presence of these minerals in powder form encountered in these quills of *H. brachyura* can also be seen as a good source of health.

In the powder of quills of *H. brachyura* sample, Arsenic was found only in detectable amount and thus below level according to the WHO standard. Cadmium, lead and mercury were not found in these samples. Thus these samples have been found to be harmless to use as medicine.

The present study has shown that powder form of quills of *H. brachyura* contain high ash, considerable presence of essential minerals and protein. Therefore these minerals and protein could provide essential amino acids, source of energy particularly important during growth and development.

Therefore the ash form of quills of *H. brachyura* used in the treatment of cough, asthma, chest injuries, mouth disease, certain gastric and intestinal disorder, oliguria, hotness of urine, gonorrhea, piles, bowel disorder, blood vomiting and white discharge, menstrual disorders in Myanmar traditional medicine (Ashin Nagathein, 1975).

Parts of these animals are still used in the medicines of traditional medical practice and found to be effective and the results of chemical analysis also clearly indicated that, these parts are harmless and can be used safely and even promote the wellbeing of the uses of traditional medicine however there is still a need to convert to synthetic materials because these raw materials currently in practice come from the natural living assets and might impose a threat in future.

Conclusion

From the results obtained on chemical analysis of these animal`s parts, it could be said that these samples contain good source of minerals. The harmful contents like arsenic, lead, cadmium and mercury were not found in these samples. Proximate analysis showed that quills of *Hystrix brachyura* contains large amount of protein up to 92.65 ± 2.53. The considerable amounts of fibers were found in these samples. Thus the above findings indicated that these animal parts may be used safely in the Myanmar traditional medicine.

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