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Research Article

PROXIMATE ANALYSIS AND MINERAL (ELEMENTAL) COMPOSITION OF CERTAIN SPICES OF MANIPUR, INDIA

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ABSTRACT

The study aim to estimate the proximate composition and mineral (elemental) content of different parts of nine spice plants namely, *Anethum graveolens* L., *Allium hookeri* Thwaites, *Allium ramosum* L.., *Citrus hystrix* DC., *Eryngium foetidum* L., *Houttuynia cordata* Thunb., *Lepidium sativum* L., *Polygonum posumbu* Buch.-Ham. ex. D. Don and *Zanthoxylum acanthopodium* DC. The proximate composition of ash, crude fibre, fat, carbohydrate, crude protein and moisture were determined using standard methods. The elemental concentration was determined using atomic absorption spectrophotometer (AAS). All the samples have a relatively high moisture content when compared to ash, crude protein, crude fat, crude fibre and total carbohydrate content. The crude proteins in the samples ranged from 34.993±0.303 to 15.035±0.075%. There was a significant variation in the crude fat content that ranged between 3.182±0.070 to 1.433±0.019%. The leaves of *Z. acanthopodium* DC, recorded the maximum amount of crude fibre that corresponds to a value of 7.290±0.115%. Macronutrients such as calcium and magnesium were present in significant amount in all the spice samples. Among micronutrients Fe, Mn, Cu, Zn and Ni were present at varied concentrations. The study showed that the spice plants are nutritionally rich in addition to their role as flavouring agents. These results will contribute to the knowledge of nutritional properties of these plants and may be useful for the evaluation of dietary information.

Keywords: proximate composition, mineral, nutritive values, AAS, spice plants, flavouring agents.

INTRODUCTION

Plant materials form a major portion of the diet and their nutritive value is important in determining the growth and developments of all human beings[1]. Proximate principles as they are sometimes referred to, carbohydrates, fats and proteins form the major portion of the diet, while minerals and vitamins form comparatively a smaller part[2, 3]. Relative concentrations of various nutrients such as proteins, fat, carbohydrate, vitamins and minerals determines the quality of food. Proximate analysis in plants gives valuable information on moisture content, ash content, volatile matter, content, ash, fixed carbon etc. and help to access the quality of the sample.

Herbs and spices, have been used for several purposes since ancient times. The specific uses of spices tend to vary considerably among cultures and countries: medicine, religious rituals, cosmetics, perfumery, and foods. As food, they have been shown to play an important role in health partially as sources of nutrient [4, 5]. Irrespective of race, civilization and culture the use of plant product as spice is prominent. Spices are the agents which provide flavor to our food[6]. It is widely accepted that herbs and spices are significant nutritional sources of minerals. There is a surge of interest in the field of mineral research due the importance of dietary minerals in the prevention of several diseases coupled with significant developments in the field[7, 8]. Mineral elements, both major and trace are of critical importance in the human diet even though they comprise meagre portion of the diet. Major minerals that include calcium, phosphorus, magnesium, sulphur, potassium, chloride and sodium, are those required in amounts greater than 100 mg per day. Essential trace elements that include zinc, iron, silicon, manganese, copper, fluoride, iodine and chromium subsequently make up less than 0.01% of the body weight and are required in much lesser amounts of less than 100 mg per day[9].

Spices, although used primarily for their desirable flavour and odour, they may play other important roles in food systems. The nutritional and medicinal properties of herbs and spices may be interlinked through phytochemicals, both nutrient and non-nutrients[10]. Although previous works on these aspects have revealed spices as the potential sources of lipids, proteins and minerals[11, 12]. These studies were limited in terms of the types of spices studied. The proximate composition and nutritional profile of spices are seldom studied. As such, the current investigation deals with the estimation of nutritive composition and mineral contents of different parts of nine plants that are commonly used as spices in the state of Manipur, India. Apart from contributing knowledge about the nutritional properties, the results may be useful for the evaluation of dietary information of these spices.

MATERIALS AND METHODS

Plant materials

Nine spice plants of *Allium ramosum* L., *Allium hookeri* Thwaites, *Houttuynia cordata* Thunb. *Polygonum posumbu* Buch.-Ham. ex. D. Don, *Lepidium sativum* L., *Eryngium foetidum* L., *Anethum graveolens* L., *Zanthoxylum acanthopodium* DC and fruits of *Citrus hystrix* DC, were collected from local plots and authenticated. The voucher specimens were preserved in the Herbarium of Department of Life Sciences, Manipur University, Canchipur, Imphal, Manipur, India-795003. The plant parts were shed dried and stored in air tight containers.

Estimation of ash

Two gram each of the samples was weighed in a silica crucible and heated in muffle furnace for about 5-6 h at 500°C. The crucible was cooled in a desiccator and weighed. It was heated again in the furnace for half an hour, cooled and weighed. The process was repeated till the weight became constant. The final weight gave the ash content of the samples[13].

Estimation of moisture

Two gram of each samples was taken in a flat-bottom dish and kept overnight in an air oven at 110-110°C and weighed. The loss in the weight was regarded as the measure of moisture content [13].

Estimation of crude Fat

Two gram each of moisture free samples was extracted with petroleum ether (60-80°C) in a Soxhlet apparatus for about 6-8 h. The extract was then evaporated in a pre-weighed beaker. The increased in the weight of the beaker gave the crude fat content of the samples[13].

Estimation of crude fibre

1 g each of moisture and fat free material of each sample was treated with 100ml of 0.255±.005 N H_2SO_4 and the mixture was boiled for 30 min. After filtration and washing, the residue was treated and boiled with 100ml of 0.313±0.005N NaOH solution. The filtrate was washed with hot H_2SO_4, water and alcohol. The residue was ignited and the ash weighed. Loss in weight gave the weight of the crude fibre[14].

Estimation of crude protein

The crude protein was determined following micro Kjeldahl method. The total protein was calculated by multiplying the evaluated nitrogen by a constant value of 6.25[3].

Estimation of total carbohydrate

The percentage of carbohydrate was calculated using the formula: 100-(percentage of ash + percentage of moisture + percentage of fat + percentage of protein) [3].

Estimation of nutritive value

Nutritive value of the samples was determined multiplying the values obtained for protein, fat and carbohydrate by 4.00, 9.00 and 4.00, respectively and adding up the values[3].

Mineral Analysis

For mineral analysis, the samples were digested following the procedure described by Salami and Non[15]. Briefly, samples of 1g each plant were digested with 5ml concentrated nitric acid ($HN0_3$) and 1ml each of concentrated sulphuric acid (H_2SO_4) and 60-62% perchloric acid ($HCLO_4$) and heated until white fumes of perchloric acid formed. The volume of the digest was reduced by heating but not to dryness. The flask was set aside to cool, after which the content was diluted with distilled deionized water and then filtered into a 50ml volumetric flask. The content was made up to mark with deionized water and stored until analyzed for mineral contents using Atomic Absorption spectrophotometer (AAS).

Statistical Analysis

All the data are expressed as means ± SD of three independent analysis which was carried out in triplicates. ANOVA and statistical analysis was conducted using SPSS version 12.0.

RESULT AND DISCUSSION

The proximate composition of nutritive contents of nine spice plants are depicted in Table 1. All the samples have a relatively high moisture content when compared to ash, crude protein, crude fat, crude fibre and total carbohydrate content. The leaves of *P. posumbu* has the highest moisture content with a value of 75.079±0.080% fresh weight while *H. cordata* has the least amount of moisture. Ash content, regarded as an index of mineral concentrations in living things, ranged between 9.073±0.029 percent in *E. foetidum* leaves to 1.048±0.008 percent in the leaves of *H. cordata*. There was a wide variation in the amount of crude protein among the extracts of the samples and ranged between 20.858±0.020 to 5.444±0.040% of dry weight. The maximum amount of crude protein was found in the leaves of *A. graveolens* (20.858±0.020%), while the minimum was recorded in the leaves of H. cordata (5.444±0.040%). The percentage crude protein of *Z. acanthopodium* was reported to be 28.06±0.14% in the previous finding of Seal[15]. In the current investigation, the percentage crude protein *of Z. acanthopodium* was found to be 15.592±0.022% of dry weight. The study reveals that the protein content of the spices under investigation were good source of protein and were richer source compared to some commercial and nutritive leafy vegetables[2].

The crude fat content was in the range of 3.182±0.070% to 1.433±0.019% of dry weight. The crude fat was maximum in the peel of *C. hystrix* (3.140±0.117) and the least content was found in the leaves of *P. posumbu* (1.433±0.019). The ash content was highest in *L. sativum*, while *A. ramosum* recorded the least percentage content among the samples studied. Crude fibre ranged from 7.290±0.115% in *Z. acanthopodium* to 2.149±0.018% in *A. graveolens*. The crude fibre contributes to weight, bulk and softness of faecal matter and has been reported to prevent constipation, reduce incidence of coronary and breast cancer[17]. The maximum amount of crude fibre was found in the leaves of *Z. acanthopodium* while the minimum amount was found in the leaves of *A. graveolens*. Carbohydrate constitutes a major class of naturally occurring organic compounds which are essential for the maintenance of life in plant and animals and provide raw materials for many industries[18]. The maximum amount of total carbohydrate was recorded in the leaves of *H. cordata* (24.551±0.106%) while the minimum amount was found in the *A. graveolens* (3.590±0.018%). The proximate analysis of the nutritive contents of different parts of nine plants that are commonly used in the state of Manipur, India established that nutritive value of the leaves of *H. cordata* (1361.186±1.084 cal Kg^{-1}) was maximum while the leaves of *the P. posumbu* (766.184±3.655 cal Kg^{-1}) was the least nutritive among the tested samples.

Table 1: Nutritive compositions of the spice plant samples

Samples	Parts used	Crude Protein (%)	Crude Fat (%)	Ash (%)	Moisture (%)	Crude fibre (%)	Total Carbohydrate (%)	Nutritive value (cal Kg^{-1})
A. graveolens	Leaves	20.858±0.020	1.689±0.010	2.539±0.028	71.312±0.011	2.149±0.018	3.590±0.018	1129.963±0.885
A. hookeri	Leaves	14.967±0.081	1.673±0.032	2.523±0.064	74.212±0.009	5.804±0.011	6.588±0.128	1013.587±2.508
A. ramosum	Leaves	17.006±0.072	2.133±0.042	1.567±0.026	71.960±0.115	5.204±0.005	7.344±0.096	1166.933±7.215
C. hystrix	Peel of the fruit	12.721±0.041	3.182±0.070	1.796±0.015	68.296±0.060	4.903±0.005	14.005±0.050	1354.558±6.870
E. foetidum	Leaves	11.300±0.038	2.597±0.051	9.073±0.029	74.190±0.061	7.100±0.012	2.841±0.059	799.051±6.362
H. cordata	Leaves	5.444±0.040	1.787±0.026	1.048±0.008	67.170±0.050	4.610±0.019	24.551±0.106	1361.186±1.084
L. sativum	Leaves	9.810±0.015	2.941±0.052	1.356±0.005	72.112±0.123	5.897±0.012	13.781±0.086	1208.323±7.676
P. posumbu	Leaves	7.271±0.028	1.433±0.019	7.548±0.015	75.079±0.080	6.826±0.107	8.670±0.058	766.184±3.655
Z. acanthopodium	Leaves	15.592±0.022	2.463±0.071	7.802±0.007	69.114±0.010	7.290±0.115	5.029±0.072	1047.147±5.987

Values are expressed as the mean of three replicates ± SD and the mean differ significantly at ($p<0.05$) level.

Table 2: Elemental composition of the spice plant samples determined by AAS

Sample	Ca	Mg	Mn	Ni	Cu	Zn	Fe
A. graveolens	196.453±0.600	56.960±0.525	0.340±0.042	0.181±0.006	0.171±0.006	0.115±0.007	2.260±0.063
A. hookeri	183.973±0.801	54.413±0.431	0.344±0.018	0.185±0.022	0.240±0.004	0.271±0.010	1.709±0.051
A. ramosum	72.427±0.455	32.320±0.640	0.217±0.027	0.079±0.028	0.231±0.012	0.127±0.006	1.072±0.070
C. hystrix	65.307±0.743	28.387±0.546	0.189±0.030	0.144±0.012	0.152±0.008	0.063±0.013	1.255±0.057
E. foetidum	473.000±0.564	54.400±0.952	0.296±0.025	0.381±0.021	0.241±0.012	0.112±0.012	1.080±0.073
H. cordata	55.427±0.932	49.040±0.560	0.079±0.008	0.072±0.008	0.155±0.034	0.108±0.007	1.883±0.027
L. sativum	87.907±0.744	44.680±0.673	0.508±0.025	0.096±0.017	0.267±0.018	0.068±0.004	1.671±0.034
P. posumbu	387.880±0.915	49.333±0.774	0.419±0.016	0.260±0.026	0.167±0.016	0.164±0.008	1.043±0.059
Z. acanthopodium	216.440±0.799	91.627±0.881	0.297±0.024	0.117±0.006	0.156±0.030	0.109±0.006	1.655±0.048

Values (mg/100 g) are expressed as the mean of three replicates± SD and the mean differ significantly at ($p<0.05$) level.

The availability of various elements is attributed to the composition of the soil, water and atmospheric condition as well as permissibility selectivity and absorbability of plants for the uptake of different elements. The major minerals such as Na, K, P, Ca and Mg serve as structural components of tissues and function in cellular and basal metabolism and water and acid-base balance[19, 20]. As such an adequate intake is therefore necessary. Trace elements are essential nutrients for the sustenance of human beings with a gamut of functions. They are incorporated in the structures of proteins, enzymes, and carbohydrates to enable them participate in biochemical reactions. Trace elements with enzymes, for example, are necessary for the functioning and maintenance of the immune system[21].

The elemental composition of the spices in the present study are shown in Table 2. Different parts of the plants contain minerals like Ca, Mg, Mn, Ni, Cu, Zn and Fe in varying concentration with Ca having the highest concentration. Calcium constitutes a large proportion of the bone, blood and extracellular fluid and it is vital for the normal functioning of the cardiac muscles, blood coagulation, milk clotting and the regulation of cell permeability[3]. It also plays an important part in nerve-impulse transmission and in the mechanism of the neuromuscular system[22]. The concentration of calcium, a macro element ranged from 473.000±0.564 to 55.427±0.932 mg/100g of dry weight. The maximum concentration of calcium was found in *E. foetidum*, while least amount was recorded in *H. cordata*. Magnesium, another macronutrient was present highest in the leaves of *Z. acanthopodium* (91.627±0.881mg/100g) and the least was recorded in the leaves of *C. hystrix* (28.387±0.546 mg/100g). Among the micro elements, the amount of iron is significantly higher than copper, zinc, manganese and nickel in the samples. The amount of iron was highest in the leaves of *A. graveolens* (2.260±0.063 mg/100g dry weight), followed by *H. cordata* (1.883±0.027 mg/100g dry weight). Manganese an activator of many enzymes and the element is essential for the formation of haemoglobin[3]. This element was present in maximum concentration in the leaves of *L. sativum* (0.508±0.025 mg/g dry weight) and minimum being recorded in the leaves of *H. cordata* (0.079±0.008 mg/100g dry weight).

Zinc a component of many metalloenzymes and is an important membrane stabilizer. Apart from playing a central role in nucleic acid metabolism it is also and stimulator of immune response [3]. Zinc deficiency can cause growth retardation, hypozincemia and intestinal mal-absorption[23]. Zinc contents of spices were found in small percentages in all the species analyzed. Maximum amount of zinc was present in the leaves of *A. hookeri* (0.271±0.010 mg/100g dry weight) the least was observed in the peel of the fruit of *C. hystrix* (0.063±0.013 mg/100g dry weight). This work attempts to contribute to knowledge of the nutritional properties of these plants.

Vegetable being the rich source of carbohydrates, fats and proteins, which form the major portion of the human diet, are the cheaper source of energy and the importance of these biochemical have been established[24, 25, 26]. Besides these biochemical, moisture, fibre, and ash contents and the energy values of plant species have also been regarded important to the human health. In addition to their roles as flavouring agents, the study showed that the plant parts under investigation were nutritionally rich and contain vital nutrients in terms of proximate principles and various mineral elements. The present study on elemental composition demonstrated that the different parts of the spice plants are good sources of trace elements and would be helpful in developing new drugs that can control and cure different diseases. The investigation will further enhance the existing knowledge about the nutritional values as well as the benefits of dietary consumption of these spice plants.

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