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Effect of Different Drying Techniques on the Nutrients Content of Fish Feedstuffs

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study investigated the effect of different drying techniques (air dying, oven drying and sun drying) on the proximate composition of three fish feedstuffs; Horse radish (*Moringa oleifera*) leaves, water lily (*Pistia stratiotes*) leaves and soy bean (*Glysine max*) seed. The soy bean was boiled for 30 minutes at 100°C in water bath to reduce the effect of anti-nutritional factor (trypsin). Samples of each feedstuff were prepared and subjected to the three dying methods in triplicate treatments. Determination of proximate composition was carried out on the dried and fresh samples of each feedstuff. The results showed that moisture content of fresh *M. oleifera* leaves (65%) and *P. stratiotes* leaves (85.67%) were significantly higher (P< 0.05) than fresh *G. max* (2.67%). Higher crude protein content of 23.97% and 22.50% were recorded for oven-dried *M. oleifera* and *P. stratiotes* leaves and 39.21% for fresh *G. max* with no significant difference (P> 0.05) between the treatments. Crude lipid was significantly higher for sun dried samples of all the feedstuffs. Oven-dried samples of the three feedstuffs had the least ash, crude fiber and nitrogen free extract. The study concluded that oven drying at moderate temperature of 70^0C proved to be more effective in

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moisture removal and retention of crude protein. Furthermore, the study recommends a feeding trial to assess the potential of these feedstuffs subjected to various drying methods on growth and nutrients utilization of cultivable fish species.

Keywords: Fish feedstuffs; proximate composition; drying techniques.

1. INTRODUCTION

Animal's feedstuffs have been in the decline in recent years, because of the diminishing output of certain traditional crops. Statistics show that the country relies on imports to meet the needs of an expanding livestock and aquaculture industry [1]. This has reaches in the increase in prices of feed resources which intensify the already high cost of fish feed which have been a major problem to fish farmers in Nigeria [2]. The feed cost constitute 40 to 60 percent of the recurrent cost of most intensive fish farm ventures which affect the economic viability of the farm when cheaper alternatives are not available [3]. Fish meal is the most commonly used in fish feed which is consider to be the best ingredients due to its protein requirement of fish [4].

The anti-nutrients component of feedstuff has to be inactivated by thermal or non-thermal processing before being used to feed fish. This may be done to increase the palatability of food, increase its quality for fish feed, minimizing risk of food spoilage and produce good product from the basics ingredients. According to Aletor [5] there are several anti-nutritional factors that are very significant in plants used for human foods and animal feed. Trypsin present in soybean are factors that can interfere with the utilization of its protein. Marker and Becker [6] reported that Moringa leaves contain negligible amount of tannins, but high level of crude saponins (5%) which may have anti nutritional effects on animals.

Research on the nutritive value of some fish feed ingredients of both plant and animals sources such as plantain [7], poultry offal [8], maggot meal [9], [10], calabash seed [11], calabash seed meal [12] and water hyacinth [13] were reported. There was dearth of information on the nutritional value of horse raddish (*Moringa oleifera*), water lily (*Pistia stratiotes*)) and soy bean (*Glysine max*) subjected to various processing method. The aim of this study was to assess the nutritive value of these fish feed ingredients subjected to various processing methods.

2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out at the Fish Hatchery and Agric Chemical Laboratory of the Faculty of Agriculture, Usmanu Danfodiyo University, Sokoto, Nigeria. The experimental site is located in Sudan Savanna vegetation zone of Nigeria on latitude 13°07'78'' N and longitude of 5°12'25'' E and on 275m above sea level. The study area is characterized by a long dry season which start from October to May; with cool dry air during the harmattan; (November- February) and hot dry air during March – May. Raining season start in June and ends in September. Annual rainfall in the area ranged from 500 to 724 mm. The mean relative humidity range between 14.9% and 40% during March and June respectively. Ambient temperature can reach up to 410 C during April and May and may fall below 20°C during December and January.

2.2 Samples Collection

Moringa oleifera leaves were collected from the fish farm of the Department of Forestry and Fisheries, Usmanu Danfodiyo University, Sokoto. Water lily was obtained from Kware Lake and Soy bean was bought from Sokoto central market, Sokoto State Nigeria.

2.3 Processing Methods

Six hundred grams (600g) each of Horse radish (*Moringa oleifera*) leaves, water lily (*Pistia stratiotes*) leaves and soy bean (*Glysine max*) seed were collected were subjected to air, sun and oven drying respectively. Similarly, three batches of soy bean seed each weighed 200g and were boiled for 30 minutes before subjected to various drying methods.

2.4 Air Drying of Samples

The samples were air dried indoor and the temperature was monitored. Temperature readings were 29°C, 32.5°C, 30.5°C, 29.8°C at 6.00 am, 12.00 pm, 4.00pm and 10.00 pm

respectively. This was aided by the use of mercury glass thermometer.

2.5 Sun Drying of Samples

The samples were dried on clean concrete surface flour to prevent being blown away by wind. Samples were sun-dried for 8 hours, at a relative humidity of 780 mm/hg and the temperature readings were as follows: 30.25°C, 34.50°C, 35.23°C, 34.75°C at 10 am, 12.00 pm, 4.00 pm and 6.00 pm respectively. This was aided by the use of mercury glass thermometer.

2.6 Oven Drying of Samples

The oven drying samples were oven dried at the Agric. Chemical Laboratory using Uniscope SM9053 Laboratory Oven at 65°C for forty eight hours.

2.7 Chemical Composition of Sample Materials

The moisture content was determined by drying in an oven at 100-105°C to constant weight [14] The crude protein content was evaluated by digestion of the sample. Nitrogen determination was done using a spectrophotometer as described by Devandra et al. [15] and the crude protein was obtained by multiplying the quantity of nitrogen by the coefficient 6.25. Total lipids were determined by continuous extraction in a Sox let apparatus for 8 hours using hexane as solvent, ash by incinerating in a furnace at 550°C, crude fiber by sequential hot digestion of the defatted sample with dilute acid and alkaline and carbohydrate was calculated by difference of 100 with the sum of all contents obtained [14].

2.8 Statistical Analysis

Data obtained were subjected to analysis of variance (ANOVA) and, the treatment means were separated for significant differences following the procedure of Duncan's Multiple Range Test (Steel and Torrie, 1980). All the analyses were carried out using the computer software Statistical Package for the Social Sciences Version 9.0 for windows [16].

3. RESULTS

The results of the proximate composition of *Moringa oleifera* leaves subjected to various drying methods are presented in Table 1. The highest moisture content was recorded in fresh sample which differed significantly ($P<0.05$) from the other dying methods. The oven-dried of all samples have the moisture content (ranges from 1.13 to 2.50%) but did not differed significantly ($P>0.05$) with sun-dried samples (ranges from 2 to 4.17%). The ash content of sun-dried Moringa leaves was 12.60% which was the highest, differed from fresh- and oven-dried samples but did not differed significantly from air-dried sample. In terms of crude fiber all the dried samples did not differed significantly. The lowest crude lipid content was recorded in fresh sample with significant difference ($P<0.05$) between the treatments. The oven-dried sample recorded the highest crude protein content (23.97) with significant difference ($P<0.05$) from the other drying methods.

The proximate composition of the boiled and oven, boiled and Air, boiled and sun dried and fresh samples of soybean seed meal are showed in Table 1, the results showd that there was no significant difference ($P>0.05$) between the moisture content of boiled and air-dried, boiled and oven-dried, boiled and sun-dried, and fresh sample. The same trend was obtained with regard to the ash content. The crude fiber content of fresh soy bean was significantly higher ($P>0.05$) than the other boiled and dried samples, while in the crude fiber content of boiled and Air dried, boiled and oven dried and boiled and sun dried there were significant differences ($P>0.05$) than the fresh sample which is higher. Similarly, there were no significant differences in terms of lipid content of all the boiled and dried samples of the soy bean including the fresh. The highest crude protein content (39.21) was recorded in fresh sample of the soy bean which was not significantly difference ($P>0.05$) from that of boiled and air dried and boiled and sun dried but not of boiled and oven dried. The highest energy value of 32.79% was reported in boiled and sun dried samples and significantly difference ($P>0.05$) from the other boiled and dried samples including the fresh.

The proximate composition of the fresh and dried leaves of *Pistia strtiotes* are shown in Table 1. The results showed significant differences ($P< 0.05$) between the moisture of the air--ried, oven-dried, sun-dried and fresh samples of *Pisita* leaves. The lowest ash content (4.00%) was recorded in fresh sample of the leaves which differ significantly ($P > 0.05$) from the other dried leaves. Sun-dried *pistia* leaves recorded the

highest crude lipid which was significantly different (P< 0.05) from fresh leaves but did not differ significantly from air and oven dried samples. Oven dried *Pistia* leaves which had the highest crude protein was significantly higher (P< 0.05) than air- and sun-dried leaves with the fresh leaves. The air and sun-dried sample did not differ significantly; the same trend was obtained in nitrogen free extract.

4. DISCUSSION

The fresh leaves of *Moringa oleifera* of moisture content was within the range reported for vegetables [17]. The effective moisture removal for *M. oleifera* leaves in the drying methods applied is similar to what was reported for *Cratera religiosa* leaves and also similar trend were also reported for ash content [17]. The ash content for fresh leaves of *M. oleifera* in the present report was higher than what was reported in Council of Scientific Research, [18]. Similarly ash values recorded in the other methods of drying were also higher than those reported in Council of Scientific Research, [18]; Verma et al. [20] and Elkhalifa et al. [21]. This could probably be due to vegetation and soil fertility where this plant were obtained. The crude lipid of fresh sample of *M. oleifera* was lower than reported in Council of Scientific Research [18], but all the values of crude lipid obtained in the present study were higher than those reported by Verma et al. [20] and ElKhlifa et al. [21].

The crude protein content of oven-dried sample of *M. oleifera* was higher than fresh and other dried samples, the value was also higher than reported in ElKhlifa et al. [21]. There was no variation in the crude fiber of dried and fresh samples of the leaves. The ash content of air-dried sample (2.33%) is similar to what was reported (2.3%) by Verma et al. [20].

The crude fiber of the oven dried sample (2.17%) was lower than air dried (2.33%) and sun dried (2.50%) samples but higher than 0.9% reported by council of Scientific Research [18] The crude fiber content of sun-dried sample(2.50%) was less than the 19.21% reported by Fuglie [19] and 3.50% by Verma et al. [20].

The fresh sample had the lowest crude fiber level which is higher than what was reported by council Scientific Research [18]. In terms of crude lipids, it was least, (1.50%) in fresh leaves compared to air dried leaves (7.50%), oven dried leaves (7.17%) and sun dried leaves (7.83%). The crude lipids of fresh samples was lower than 1.7% reported by Council of Scientific Research [18] and 2.29% reported by Fuglie et al. 2001. The crude lipid of the dried sample was higher

Table 1. Proximate composition of Sample ingredients in different drying methods (% DM)

MLM	Nutritional values					
	Moisture%	**Ash%**	**Crude fiber%**	**Crude lipid%**	**C.P%**	**NFE%**
Fresh	65.00^{a}	3.27^{c}	1.67^{a}	1.50^{b}	9.53^{c}	84.03^{a}
Air dried	3.00^{b}	12.37^{ab}	2.33^{a}	7.50^{a}	20.20^{b}	57.60^{b}
Oven dried	1.13^{c}	11.77^{b}	2.17^{a}	7.17^{a}	23.97^{a}	54.93^{c}
Sun dried	2.03^{c}	12.60^{a}	2.50^{a}	7.83^{a}	20.03^{b}	56.70^{bc}
	SE=0.50	SE = 0.18	SE = 0.25	SE = 0.37	SE = 0.26	SE = 0.64
SBSM						
Fresh	2.67^{a}	4.67^{a}	6.17^{a}	20.40^{a}	39.21^{a}	28.46^{c}
Air dried	2.50^{a}	4.39^{a}	4.17^{c}	20.83^{a}	36.98^{b}	31.13^{b}
Oven dried	1.67^{a}	4.00^{a}	4.83^{b}	20.50^{a}	38.94^{a}	30.06^{b}
Sun dried	2.00^{a}	4.50^{a}	4.33^{bc}	21.17^{a}	35.20^{c}	32.79^{a}
	SE = 0.31	SE = 0.30	SE = 0.16	SE = 0.24	SE = 0.23	SE = 0.42
PLM						
Fresh	85.67^{a}	4.00^{b}	1.49^{a}	2.50^{b}	8.53^{c}	82.47^{d}
Air dried	5.50^{b}	29.17^{a}	2.27^{a}	3.67^{a}	18.30^{b}	46.60^{b}
Oven dried	2.50^{b}	28.17^{a}	1.93^{a}	3.53^{a}	22.50^{a}	45.87^{b}
Sun dried	4.17^{c}	29.83^{a}	2.50^{a}	4.33^{a}	17.37^{b}	45.97^{b}
	SE = 0.37	SE = 0.64	SE = 0.26	SE = 0.31	SE = 0.35	SE = 0.87

Values in a column denoted by same letters are not significantly different (P>0.05). NFE: Nitrogen free extract, C.P; crude proteins; SBSM, Soybean seed meal; PLM, Pistia stretiotes leaves meal and MLM, Moringa oliefera leave meal

than the 2.29% reported by Fuglie et al. [19] 1.7 by ElKhlifa et al. [21] and 1.7 by Verma et al. [20] The crude protein content of oven dried was higher than the CP of other dried and fresh leaves. The CP of *Moringa oleifera* fresh leaves 9.53% was higher than 6.7% reported by Council of Scientific and Industrial Research [18], but lower than 16.70% reported by ElKhalifa et al. [21] The CP of each the dried leaves was higher than 16.70 reported by ElKhalifa et al. [21] but lower than 27.08% reported by Fuglie et al. [19]. The fresh leaves had the highest NFE (84.03%) than air dried, oven dried and sun dried leaves.

5. CONCLUSION

The results of this study shows that *Pistia stratiotes* leaves and *Moringa oleifera* leaves are good sources of minerals, carbohydrate moderate protein as compared to boiled and dried soybeans which had low minerals, low carbohydrate content, higher lipid and higher protein contents. Processing methods were found to have effects on moisture, ash, crude fiber, crude protein crude lipid and soluble carbohydrate in all the three feedstuffs, but protein retention was highest in oven dried samples.

6. RECOMMENDATION

Based on the findings the following recommendations were drawn: The samples should not be sun dried, rather air dried in an enclosure or under shade, if oven drier is not unaffordable as the former reduced protein content. As observed in this study that the boiled and dried soybean has the highest protein composition than Moringa and pistia leaves, thus, fish farmers could use soybeans as already being done as a source of protein in their feed formulation.

It has been seen that from all the results finding the vegetable plants have higher moisture contents, but pistia (aquatic plant) had the highest moisture than Moringa (terrestrial plant) in view of that, the leaves should be dried using fast effective drying techniques such as oven dried to prevent the leaves from microbial attack and subsequently spoilage. Further studies should be carried out to test the nutritional values of moringa and pistia leaves using cultured fish species.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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