

Effect of Drying Methods on the Nutritive Value of Some Aquatic Macrophytes in River Rima, North Western Nigeria

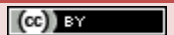
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Abstract

A comparative study on the effectiveness of different drying methods on the nutrient contents of water hyacinth (*Eichorniacrassipes*), Water lilly (*Nymphae lotus*) and water primrose (*Ludwigiahysopifollia*) leaves was carried out in order to ascertain their potential as nutrient supplements in fish feed formulation. Whole components of each plant were weighted and 600g each of the leaves were separately weighted in triplicates and was subjected to oven drying, sun drying and air drying. Results of analysis indicated that oven dried leaves of *Ludwigiahysopifollia* had significant ($p < 0.05$) high crude protein (15.13 ± 0.01) than sun dried and air dried (11.64 ± 0.01 and 4.84 ± 0.60), this follows the same trend with *Eichorniacrassipes* and *Nymphaea lotus* 12.52 ± 0.12 and with 11.76 ± 0.02 respectively. The ash, crude fiber and crude lipid contents exhibit no significant ($p > 0.05$) difference in the oven drying method of the three plants. Moisture content differs significantly ($p < 0.05$) in *Eichorniacrassipes* in all the drying methods, higher values Nitrogen Free Extract were recorded in each drying method. The percentage composition of leaves shows that *Ludwigiahysopifollia* has 64.74% *Eichorniacrassipes* has 16.01% and *Nymphaea lotus* 55.95%. The study concluded that oven drying recorded the best effect on the nutrients contents of the plant leaves this grossly followed by air and sun drying method, and also the leaves of these macrophytes can be used to substitute conventional carbohydrate not protein supplements in fish feeds. Further studies should be carried to assess the potential of these macrophytes subjected to the various drying methods in feeding cultured fish species.

Keywords: Drying method, Nutritive values, Aquatic macrophyte.



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1. Introduction

Nutrition is vital in fish farming because feed cost represent 40-50% of the total variable cost of production [1-3]. For several decades fishmeal has been used as the main sources of protein in fish feeds [4, 5], however, the periodically occurring low availability, competition and continuously fluctuating price of fish meal and other animal protein sources are affecting aquaculture feed production [6, 7]. As a result, a lot of attention has been focused on feedstuffs alternative to fish both from animal and plant sources [5].

In Nigeria, most water bodies are flourished with large quantity of aquatic macrophytes as weed covering most part of water surface [8, 9]. Studies into the possibility of converting these macrophytes into economically useful materials will help a lot in curbing their menace [8, 10]. In aquaculture, the increasing cost, and scarcity of fishmeal plus other ingredients rich in protein of both plant and animal sources have resulted in fish nutritionist seeking alternative sources from non-conventional feed ingredients such as macrophytes. The potential of fresh water vascular plants as feedstuffs has been emphasized [11]. A few species appear to be suitable raw materials for leaf protein extraction, which can be used as human and non-ruminant animal feed in the tropics.

The use of various ingredient of plant origin with nutritive value in order to reduce variable cost of production has been documented. These includes plantain peel [12], calabash seed [13-15], Moringa oleifera seed meal [16], calabash seed meal [17]. However, there is dearth of information on the nutritional values of these plants when subjected to various drying methods. Therefore, the objective of this study is to assess the potential of some aquatic macrophytes subjected to different drying methods as valuable ingredient in fish diets.

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.

2.2. Samples Collection

All samples of the study was collected from River Rima in Kwalkwalawa village, along Usmanu Danfodiyo University road (main campus) Sokoto. All the samples were collected and analyzed from October, 2012 to December, 2012.

2.3. Processing of the Samples

Weighed samples (600g) each of water hyacinth, water lily and water primrose were collected in triplicate and subjected to the different methods namely: air, sun and oven drying.

2.4. Air Drying Samples

Samples were spread under shade in the fish hatchery. Temperatures of the environment were recorded four times daily at 6.00am, 12.00pm, 4.00pm and 10.00pm respectively with mercury glass thermometer.

2.5. Sun Drying of Samples

Samples were dried under the sun on concrete floor guarded against high wind. Sun dried was carried out for 8 hours daily during which ambient temperature was recorded at 10.00am, 12.00pm, 4.00pm and 6.00pm, using mercury glass thermometer.

2.6. Oven Drying of Samples

Samples were oven dried at the Agric Chemical Laboratory using UniscopeSM9053 Laboratory Oven at 65⁰ C for forty eight hours.

2.7. Assays

Moisture content was determined by drying in an oven 100-105⁰ C to constant weight [18]. The crude protein content was evaluated by digestion of the sample, nitrogen determination by a spectrophotometer method as described by Devani, et al. [19] 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. Ashing was carried out by incinerating in a furnace at 550⁰ C. Crude fiber was determined by sequential hot digestion of the defatted sample with dilute acid and alkaline. Total carbohydrate was determined by difference (100- moisture, crude protein, ash, crude fiber and crude lipid) [18].

2.8. Statistical Analysis

Data obtained were subjected to analysis of variance (ANOVA) in a Completely Randomized Design (CRD) and, treatment means were separated for significant differences using Duncan's Multiple Range Test [20]. The analyses were carried out using the computer software Statistical Package for the Social Sciences Version 9.0 for windows [21]

3. Results

The proximate composition of water hyacinth (*Eichornia crassipes*), water lily (*Nympae lotus*) and water primrose (*Ludwigia hyssopifolia*) subjected to various drying methods (air dried, ovum dried and sun dried) are shown in table 1. There were no significant differences ($P > 0.05$) between the moisture content of the air dried samples between the treatments. However, other methods (ovum dried and sun dried) differ significantly ($P < 0.05$). Similarly, ash content follows the same trend, with higher values recorded in ovum dried method. The highest crude

protein was recorded in ovum dried method with no significant difference ($P > 0.05$) between the treatments; similarly the crude protein content of air dried did not differ significantly between water hyacinth and water lily but differ significantly ($P < 0.05$) with water primrose. Water hyacinth recorded highest value of fiber content (5.2 ± 0.12) in ovum dried method with no significant difference between the treatments; however other methods exhibit a significant difference. The highest value of crude lipid (4.51 ± 0.01) was recorded in ovum dried method for water primrose, however the value did not differ significantly ($P > 0.05$) with those of water lily but other methods differ significantly between the treatments. Higher energy values were recorded in the air dried method for water primrose with no significant difference ($P < 0.05$) from sun dried method employed for water hyacinth and water lily respectively. Table 2 shows the percentage composition of the whole plants used for the analysis.

4. Discussion

The highest moisture content was recorded air dried samples in all the treatments. This observation was in line with Boyd [11] who reported that water hyacinth (*Eichornia crassipes*) when dried contain as much as 7% moisture, the author further stated that the plant contain higher moisture and fiber content. The higher moisture contents in air dried samples in all treatments could have been attributed to the temperature and relative humidity of the air and the duration of the drying. The moisture content of water lily (*Nymphae lotus*) reported in the present study were similar to those of *Cratera religiosa* reported in Hassan, et al. [22]. Lowest moisture content was recorded water primrose (*Ludwigia hyssopfiSlia*) subjected to ovum drying method. Similarly, the ash content reported in the study of the aquatic macrophytes with response to the drying methods employed where in conformity with Boyd [11] and this therefore is indicating that the aquatic could beneficially serve as good sources of minerals for aquaculture.

The crude protein contents reported in the present study for (*Eichornia crassipes*) is higher in all the drying methods than those reported in Kusemiji and Akingboju [23], this could have been resulted to the soil fertility of habitat in which the plant grow. The crude protein content for *Nymphae lotus* in oven dried method was higher than the crude protein of the other drying methods, however the were higher than those reported in Anjana and Matai [24], lower than obtained in Mohammed, et al. [9]. The reason this variation could have been influenced by processing method and techniques employed in the processes. Oven dried method adopted for *Ludwigia hyssopfiSlia* recorded the highest crude protein which was significantly different from the other dried product, this could be attributed to the combination of moderate temperature and duration of drying. A moderate temperature over short period of time result in considerable retention of nutrient such as vitamins and certain minerals like calcium, iron and zinc.

The fiber contents reported in the present study with all the aquatic plants subjected the various drying method were within the 5% base line fiber content for monogastric animals including fish [25]. However, the fiber content reported in the study with regard to *Nymphae lotus* was lower than reported in [9, 24]. Higher crude lipid were recorded in *Ludwigia hyssopfiSlia* exposed to various drying method, the values obtained than those reported in the leaves of *Eichornia crassipes* [26], also higher than those reported for the other plants in the present study. Carbohydrate levels reported in the present finding was relative higher in all the macrophytes subjected to various drying method, this is a clear trend that the plants could serve betterment as energy sources.

5. Conclusion

The finding of the is revealing that water hyacinth (*Eichornia crassipes*), water lily (*Nymphae lotus*) and water primrose (*Ludwigia hyssopfiSlia*) could serve as good source of carbohydrate rather than protein, the processing methods were found to have effect on moisture, ash, crude protein, crude fiber, crude lipid and carbohydrate in all the three macrophytes but protein retention was higher in oven dried samples. The study recommends oven dried methods in all the samples if it is economically justifiable, further studies should be carried to assess the potential of these macrophytes subjected to various drying method highlighted using cultured fish species.

Table-1. Proximate composition of aquatic macrophytes on different drying methods (%)

Samples	Drying methods	Moisture	Ash	Crude Protein	Crude Fiber	Crude Lipid	NFE
water hyacinth <i>Eichornia crassipes</i>	Air Dried	7.05±0.03 ^a	14.33±0.17 ^b	12.36±0.02 ^b	4.50±0.29 ^b	2.01±0.06 ^b	60.06±0.01 ^b
	Oven Dried	6.91±0.01 ^b	15.37±0.13 ^a	12.52±0.02 ^a	5.20±0.12 ^a	2.50±0.03 ^b	58.05±0.02 ^c
	Sun Dried	6.60±0.06 ^c	14.47±0.03 ^b	11.08±0.01 ^c	4.25±0.01 ^b	2.52±0.02 ^a	61.00±0.50 ^b
Water lily <i>Nymphae lotus</i>	Air Dried	6.32±0.06 ^a	21.35±0.17 ^b	8.55±0.25 ^b	4.57±0.09	2.89±0.06 ^c	55.46±0.14 ^c
	Oven Dried	6.25±0.03 ^b	23.42±0.02 ^a	11.76±0.02 ^c	4.97±0.03	3.95±0.03 ^a	50.03±0.48 ^c
	Sun Dried	6.39±0.06 ^a	19.90±0.10 ^c	7.57±0.32 ^c	4.99±0.07	3.56±0.32 ^b	57.86±0.89 ^a
Water primrose <i>Ludwigia hyssopfiSlia</i>	Air Dried	6.20±0.03 ^a	8.22±0.15 ^b	4.84±0.60 ^c	2.52±0.01	4.03±0.03 ^b	74.02±0.11 ^a
	Oven Dried	5.96±0.02 ^b	3.34±0.17 ^b	15.13±0.01 ^a	3.20±0.11 ^a	4.51±0.01 ^a	67.94±0.31 ^b
	Sun Dried	6.12±0.06 ^a	8.51±0.01 ^a	11.64±0.01 ^b	3.10±0.01 ^a	4.49±0.01 ^b	66.29±0.04 ^b

Means in rows with the same letters are not significantly different ($P > 0.05$)

Table-2. Percentage composition of whole plants part

Aquatic macrophytes	Components	Weight (g)	Composition (%)
Water hyacinth <i>Eichornia crassipes</i>	Leaves	600	16.01
	Stem	3081.0	82.20
	Root	67.03	1.79
	Total	3748.03	100
Water lily <i>Nymphae lotus</i>	Leaves	600	55.95
	Stem	290.886	27.12
	Root	181.609	16.93
	Total	1072.495	100
Water primrose <i>Ludwigia hyssopifolia</i>	Leaves	600	64.75
	Stem	326.648	35.25
	Root	-	-
	Total	926.648	100

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