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# A COMPARATIVE STUDY ON THE QUALITY OF FROG MEAL PREPARED BY DRYING FROG WASTE IN SUN AND AT VARIOUS TEMPERATURES IN ELECTRIC OVEN

A. K. M. Aminullah Bhuiyan*, S. Gheyasuddin**, M. A. Mansur and Sheema Chowdhury
*Department of Fisheries Technology, Bangladesh Agricultural University, Mymensingh, Bangladesh*

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Effect of drying the frog waste in sun and at various oven temperatures on the quality of frog meals was studied. Proximate composition, characteristics of lipids in terms of iodine and free fatty acid values and *in vitro* protein digestibility of the meal were used as quality indices. The period of drying reduced considerably with increasing temperature and dehydration was more complete at higher than at lower temperature. Temperatures had considerable effect on the lipid fraction. Extent of rancidity as reflected in iodine and free fatty acid values was much less at higher than at lower temperatures. But the *in vitro* digestibility of protein by pepsin was not affected noticeably in comparison to the changes in lipid quality with temperature difference. Sun dried meal underwent the greatest rancidity and had the lowest protein digestibility.

***Key words***: Frog meal, Drying temperature, Frog meal quality.

## Introduction

In recent years frog legs have been recognized as an important food commodity for export as well as for internal consumption in a number of countries of the world. In India of the total export value of Rs. 287 crores of the marine products frozen legs constitute a share of 5.8% by quantity and 4.11% by value [10]. Brazil produces around 40 tonnes/month of dressed frog meat and the entire production is absorbed by the domestic market [7]. Even in Bangladesh, frog leg export has earned considerable foreign exchange for this country until recently. But in doing so frog which have so far been obtained from natural resources, have been over harvested almost beyond the sustainable limit. Considering the long-range effect depletion of frog on the ecology of the country, the Government had to stop the harvest of the frogs by legislation. The importance has now shifted on the culture of the frog in this country. It is expected that soon the country will again start the export of the frog legs.

As only the hind legs are exported the remaining parts called waste pose a disposal problem have until been considered a nuisance particularly in third world countries. A number of reports are available which indicate that this frog waste could be utilized as a protein source in animal diets. Production of silage from frog waste in Bangladesh as animal feed was recommended [6]. Fish feed, containing basal ration of frog waste meal as a major source of protein was successfully used [4]. A diet containing frog meal was reported to give good results on the growth of *Sarotheradon nilotica* [12].

However, reports regarding the suitable drying temperature for preparation of frog meal are conflicting. Various temperatures have been recommended without indicating the quality of the product. The knowledge that use of unnecessary high temperature adversely affects the nutritive quality of the product and that lower temperature take longer time for drying creating a better environment of bacterial spoilage makes it important to find out a suitable temperature for drying. The work was, therefore, undertaken to find out an optimum temperature for the production of quality frog meal. Besides, sun drying vis'-a-vis' oven drying was also compared.

## Material and Methods

*Collection and treatment of raw material.* Frogs *Rana tigrina* were collected alive from a local agent. In the laboratory, the frogs were narcotized by placing them in 10% NaCl solution for 10 mins in a tub. Then they were washed with fresh water and their hind legs were removed. The remaining portion of the body was chopped finely.

*Drying of frog waste.* The materials were then spread on enamel trays and dried in an electric oven at following temperature. 70, 80, 90, 100, 110° and in sun.

*Grinding and storage.* The dried frog wastes were ground into powder and sieved to get uniform particle size. The product was then kept in sealed polyethylene bags for further use.

*Bio-chemical analysis.* Proximate composition and the *in vitro* protein digestibility of raw frog wastes and the meal was determined according to the AOAC methods [2].

Iodine and free fatty acid values of lipid obtained by extracting the sample with Folch Reagent ($CHCl_3$: $CH_3OH$:: 2 : 1) were also determined by AOAC methods [2].

In each case an average value of three determinations have been reported.

## Results and Discussion

The waste constituted 60.4% of the total body weight and roughly for every kg of the waste some 0.25 kg of meal

* Fisheries Research Institute, Mymensingh, Bangladesh.
** Department of Biochemistry, Bangladesh Agricultural University, Mymensingh, Bangladesh.

was produced. The percentage of moisture, ash, crude protein and lipid in the frog waste were found to be 74.9, 5, 17 and 2.64% respectively. Published reports on the proximate composition of frog waste are rare. However, Banu *et al.* [3] found 76.52% moisture, 19.25% crude protein, 2.84 lipid and 1.73% ash in frozen frogleg meat. Dani *et al.* [5] working with the leg meat of two edible species of frogs *Rana hexadactyla* and *Rana tigrina* found that the moisture content in the two species respectively were 79.8 and 79.6%, crude protein 16.4 and 17%, lipid 1.7 and 1.2% and ash 1.0%.

Time required for drying the frog waste in electric oven at different temperatures and in sun are reported in Table 1 (Fig. 1). The period required for drying varies considerably ranging from some 20.5 hrs at 70° to 7.5 hrs at 110°. The results of the proximate analysis of meals prepared at different temperatures from waste are also presented in the Table 1. Considerable variation in moisture content among the products are at once apparent indicating the drying was not carried out to the same extent in every case. Besides, the products obtained from the frog waste contained different compositions at various temperatures. For a correct comparison of the quality of the products in terms of protein and lipids - the two important nutrients of a feed-stuff - it is necessary, therefore, to convert the values on moisture free basis. This need becomes apparent when we first analyze the unconverted data. Thus the meals produced by drying at 110° seem to have the highest crude protein and lipid content (63 and 17.52% respectively) whereas the product prepared by drying at 70° had the minimum (61.58 and 14.21%). But the picture changes altogether when we consider the data on moisture free basis. The meals produced by drying at 70° are now found to contain the highest contents of protein (68.31%) and lipid content was 15.76%. Ali [1] found 62.48% crude protein, 17.52% fat, 11.53% moisture and 8% ash in frog meal Nair *et al.* [11] reported 66.6% crude protein and 23.5% ash in frog meal. However, the drying temperatures for their findings were not reported. At the temperatures of 70 and 80° drying was stopped after 20.5 and 17 hrs respectively and in sun after 29.5 hrs. Because after this period the loss of moisture was imperceptibly slow, i.e. for all practical purposes the meal was considered dry in terms of the corresponding drying temperature. At temperature of 110° the moisture loss was rapid and fell down at as low as 0.77%. At this temperature there was apparently some loss of crude protein (on dry basis). This was due to leaching at this temperature and also perhaps loss of volatile N-material.

For production of meal on an industrial scale, however a number of points have to be taken into account, mainly the quality of the product and econometric of the production. Time required for drying is obviously of considerable concern. Long period of drying involves more manpower and higher expenditure of energy. This obviously adds to the cost of the final product. Thus drying at low temperatures which takes long time is not feasible from industrial point of view. But high temperatures while they shorten the period of drying, adversely affect the quality of the meal which is often not reflected to that extent in its proximate composition. High temperatures are known to reduce the nutritional quality by destroying some essential amino acids of the proteins besides decreasing their *in vitro* digestibility. As it can be seen from the data (Table 1) the protein percent of the product at 110° is little

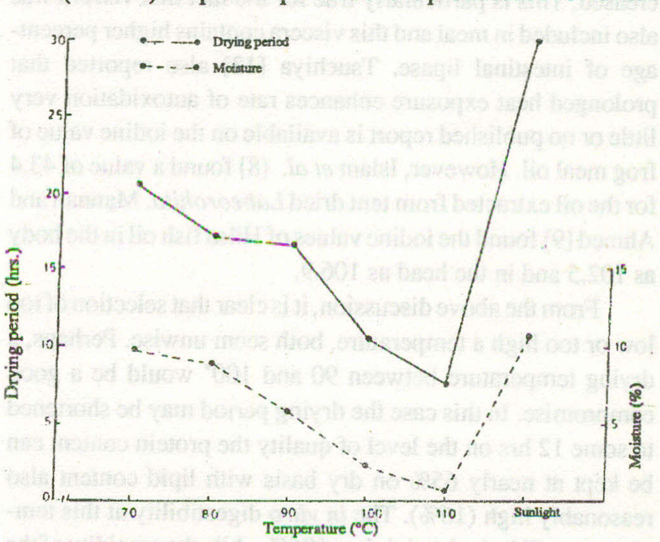


Fig. 1. Temperature, time and moisture relationship.

TABLE 1. PROXIMATE COMPOSITION OF FROG MEAL DRIED AT DIFFERENT TEMPERATURE AND IN SUN LIGHT.

| Temperature (in °C) | Moisture (%) | Ash (%) | Crude protein (%) | Fat (%) | Drying period (hrs) |
|---|---|---|---|---|---|
| 70 | 9.85 | 8.3 (9.20) | 61.58 (68.31) | 14.21 (15.76) | 20 1/2 |
| 80 | 8.92 | 8.5 (9.33) | 61.72 (67.76) | 15.24 (16.73) | 17 |
| 90 | 5.95 | 8.3 (8.82) | 61.99 (65.91) | 15.44 (16.42) | 16 1/2 |
| 100 | 2.42 | 8.5 (8.71) | 62.42 (63.97) | 17.26 (17.69) | 10 1/2 |
| 110 | 0.77 | 8.2 (8.26) | 63.06 (63.55) | 17.52 (17.66) | 7 1/2 |
| Sun light | 10.84 | 8.4 (9.42) | 60.10 (67.41) | 13.59 (15.24) | 29 1/2 |

*Data in parenthesis are on moisture free basis.

TABLE 2. IODINE AND FREE FATTY ACID VALUES OF LIPIDS AND *IN VITRO* DIGESTIBILITY OF PROTEIN OF THE MEAL PREPARED BY DRYING AT DIFFERENT TEMPERATURE AND IN SUN.

| Temperature in °C | Iodine value | Free fatty acid value % | Protein digestibility % |
|---|---|---|---|
| 70 | 16.77 | 15.00 | 98.67 |
| 80 | 22.77 | 11.60 | 96.86 |
| 90 | 26.65 | 9.10 | 96.00 |
| 100 | 27.39 | 9.40 | 96.63 |
| 110 | 46.57 | 5.70 | 96.70 |
| Sun light | 13.87 | 18.60 | 95.46 |

over 63% compared to the product at 70° which contains some 68%. Furthermore, the *in vitro* protein digestibility is also reduced slightly compared to meal produced at low temperatures (Table 2).

Drying at low temperatures tend to produce rancidity of the lipid. Table 2 presents the data on iodine and free fatty acid values of the lipid produced from the meals prepared at different temperatures. At low temperatures, because of the length of period of drying, the iodine value is lowered and free fatty acid values presumably due to lipolytic action is increased. This is particularly true for the fact that viscera was also included in meal and this viscera contains higher percentage of intestinal lipase. Tsuchiya [13] also reported that prolonged heat exposure enhances rate of autoxidation very little or no published report is available on the iodine value of frog meal oil. However, Islam *et al.* [8] found a value of 43.4 for the oil extracted from tent dried *Labeorohita*. Mannan and Ahmed [9] found the iodine values of Hilsa fish oil in the body as 102.5 and in the head as 106.9.

From the above discussion, it is clear that selection of too low or too high a temperature, both seem unwise. Perhaps, a drying temperature between 90 and 100° would be a good compromise. In this case the drying period may be shortened to some 12 hrs on the level of quality the protein content can be kept at nearly 65% on dry basis with lipid content also reasonably high (16%). The *in vitro* digestibility at this temperature will be in the vicinity of 96% while the rancidity of the lipid would not have proceeded to any great extent.

From the data reported it is also seen that drying in sun takes nearly 30 hrs and the protein content is quite high (over 67% on dry basis) but the lipid content although comparable with those dried at 70 and 80° undergo considerable rancidity as indicated by the lowest iodine and the highest FFA values. Furthermore the protein digestibility is also the lowest (little over 95%). From the industrial point of view although sun drying is the cheapest yet considering the time required for drying and the deterioration in quality it can hardly be recommended. Furthermore, sun drying is possible and profitable only in winter in Bangladesh. In other words, sun drying cannot ensure year round supply of frog meal.

Thus from various consideration, it is recommended that the frog waste be dried at a temperature of 95°

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