Development of Health mix from Lizard Fish and its Nutritional Characteristics

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Abstract

Minced meat fish Lizard fish (Saurida tumbil) was subjected to steam cooking and acid hydrolysis process and dried up to moisture content of 6-7%. Fish powder obtained from both methods were incorporated in to a cereal mix containing malted and roasted wheat and ragi powder at different percentage (10%, 15%, 20% and 25%) separately. Prepared health mix were stored at ambient temperature and its storage characteristics such as biochemical composition, nutritional, functional, microbiological parameters and organoleptical attributes were analyzed up to 90 days. Health drinks prepared by using Lizard fish powder by acid hydrolysis is more acceptable during the storage period.

Keywords
Lizard fish, Acid hydrolys, Health mix, Nutritional characteristics

Introduction

Protein deficiency, particularly animal protein deficiency is most common nutritional deficiency in India. Per capita protein availability in India is 58g/day of which animal protein is only 9.5g against the world average of 25g (Thomas et al., 2006). Today, there is an ever increasing awareness about health foods and fish is finding acceptance for its special nutritional qualities. Rising wealth and a new focus on health foods are generating a firmer wave of demand for fish. About one billion people mostly in developing countries rely on fish as their primary animal protein source (Ferozkhan et al., 2006). To meet the increasing demand for fish, the under-utilized fish species are to be presented to the consumer as palatable attractive products.

In India, large quantities of low value fishes amounting to about 30% of the total marine catch are not properly utilized (Anon, 2001). Lizard fishes contributed about 5% of total demersal finfish landings in 2005 and its total landings in 30552 tonnes (CMFRI, 2006). Utilization of low value by catch for human consumption is mainly done in the form of mince based products.
Fish can be used as a fortifying agent to improve the food value and taste of different food items. Malting of cereals gives number of advantages like increased phosphorus availability, vitamin-C and lysine content (Dulby and Tsai, 1976). The anti-nutritional factors such as phytase, trypsin inhibitor and haemagglutinins were broken down on germination (Reddy, et al., 1978). The present work was taken up to develop fish based health mix to convert locally abundant low value fishes to nutritionally rich edible product.

**Materials and Methods**

Lizard fish (*Saurida tumbil*) caught from Thoothukudi fishing harbour was used for present study. Minced meat were obtained using deboner (M/s. Baadar 601), washed and divided into two parts. One part is steam cooked for 10 minutes and another part is hydrolysed by using 1N HCl (Setty et al., 1977) and dried at 60°C until moisture content reaches 6-7%. Both cooked and hydrolysed fish powder was mixed with cereal mix containing malted and roasted wheat and ragi powder (equal volume) at different percentage (10%, 15%, 20% and 25%). Storage behaviors were studied up to 90 days.

Moisture, protein, fat, ash, peroxide value, (PV), calcium and pepsin digestibility were determined as per standard methods of AOAC (1995). Phosphorus was estimated by the method of Fiske and subburrow (1925). Carbohydrate and available lysine were determined by the method of Sadasivam and Manickam (1992). Free fatty acids (FFA) were estimated by the method of Olley and Lovern (1960). TVB-N was estimated by the procedure of Beatty and Gibbons (1937) using Conway’s micro diffusion technique. Fat absorption capacity (FAC) was estimated by the method of Lin et al., (1974). Water absorption capacity (WAC) was determined by the method of Solsulski (1962) and microbiological parameters such as TPC, *E. coli*, Staphylococci, *Salmonella* and *Vibrio cholerae* were determined by the method of APHA (1976). Organoleptical quality of health mix value evaluated by preparing a drink in boiling water with required amount of sugar and milk powder. Sensory quality such as appearance, colour, odour and overall acceptability were tested by trained panelist.

**Results and Discussion**

In the present study, the average length and weight of Lizard fish used was 22.6cm and 93.6g respectively. The yield of minced meat from whole fish was 50.0%, Dora (1992) has reported that the dressing yield of 60% and 66% from croaker and pink perch respectively. Yield of fish meat powder is about 15.6% by cooking process and 15.0% by hydrolyzing process. The physico-chemical characteristics of fish vary with general factors such as season, size, maturity and climate. Physico-chemical, functional and microbiological characteristics of Lizard fish mince are presented in Table 1. TMA-N and PV was absent it is mainly due to repeated washing of meat at 4°C. Higher solubility (89.5%), viscosity (12.85 cp) and a Ca++ ATPase activity was 0.75 µg pi/mg protein/min indicated the freshness and conformational status of myofibrillar proteins.

Similar results reported by many workers (Numakura et al., 1989; Chan et al., 1995; Rathnakumar and Shanmasundar, 1998). Several authors have reported on the proximate composition and its nutritive value of Lizard fish (Srinivasan, 1966, Ismail et al., 1968 and Chattopadhyay et al., 2004). Fish meat had total plate count of $2.2 \times 10^4$ cfu/g, Staphylococci and *E. coli* were found to be 8.0 x $10^2$ cfu/g and 3.0 x $10^2$ cfu/g respectively. *Salmonella* and *Vibrio* were absent.
Table 1: Physico-chemical functional & microbiological characteristics of Lizard fish mince

| S. No | Parameters                      | Saurida tumbil |
|-------|---------------------------------|----------------|
| 1.    | Moisture (%)                    | 76.99          |
| 2.    | Protein (%)                     | 19.01          |
| 3.    | Fat (%)                         | 1.13           |
| 4.    | Ash (%)                         | 1.31           |
| 5.    | TMA-N (mg %)                    | Absent         |
| 6.    | TVB-N (mg %)                    | 1.4            |
| 7.    | FFA (% of oleic acid)           | 0.0022         |
| 8.    | PV (milli equivalent O₂/kg fat) | Absent         |
| 9.    | NPN (mg/100g meat)              | 194.52         |
| 10.   | pH                              | 7.01           |
| 11.   | Viscosity (Cp)                  | 12.85          |
| 12.   | Solubility (%)                  | 89.51          |
| 13.   | Ca²⁺ ATPase activity (µg pi/mg protein/min) | 0.75 |
| 14.   | Total plate count (TPC) (cfu/g) | 2.2x10⁴        |
| 15.   | Staphylococcus aureus (cfu/g)   | 8.0x10²        |
| 16.   | E.coli (cfu /g)                 | 3.0x10²        |
| 17.   | Salmonella                      | Nil            |
| 18.   | Vibrio cholera                  | Nil            |

Table 2: Physico-chemical and functional characteristics of fish meat powder from lizard fish (Saurida tumbil)

| Sl. No | Parameters                      | Lizard fish |
|--------|---------------------------------|-------------|
|        |                                 | Cooked meat powder | Hydrolyzed meat powder |
| 1.     | Moisture (%)                    | 6.02         | 7.01         |
| 2.     | Protein (%)                     | 89.63        | 88.61        |
| 3.     | Fat (%)                         | 1.05         | 0.78         |
| 4.     | Ash (%)                         | 2.06         | 3.06         |
| 5.     | Calcium (mg/100g)               | 205.58       | 250.06       |
| 6.     | Phosphorus (mg/100g)            | 287.54       | 296.37       |
| 7.     | Pepsin digestibility (%)         | 98.01        | 97.06        |
| 8.     | Available lysine(g/16g nitrogen) | 10.10        | 9.79         |
| 9.     | WAC (g water/g dried material)   | 3.20         | 3.41         |
| 10.    | FAC (g oil/g dried material)     | 1.00         | 1.20         |
| 11.    | TVB-N (mg %)                    | 1.23         | 1.19         |
| 12.    | FFA (% of oleic acid)           | 0.009        | 0.007        |
| 13.    | PV (milli equivalent O₂/kg fat)  | 0.08         | 0.07         |
Table.3 Changes in nutritional characteristics of cooked meat (Lizard fish) powder incorporated cereal mix

| Fish powder | 10% | 15% |
|-------------|-----|-----|
| Parameters  | Calcium (mg/100g) | Phosphorus (mg/100g) | Available lysine (g/16 g nitrogen) | Pepsin digestibility (%) | Calcium (mg/100g) | Phosphorus (mg/100g) | Available lysine (g/16 g nitrogen) | Pepsin digestibility (%) |
| Storage period (days) | 190.63 | 291.86 | 6.59 | 88.95 | 191.73 | 292.94 | 6.80 | 90.01 |
| | 189.722 | 290.48 | 5.83 | 88.45 | 190.94 | 291.36 | 6.29 | 89.13 |
| | 188.80 | 289.10 | 5.06 | 87.96 | 190.15 | 289.79 | 5.79 | 88.26 |
| | 185.50 | 282.47 | 3.86 | 86.59 | 186.84 | 284.69 | 4.37 | 87.30 |

| Fish powder | 20% | 25% |
|-------------|-----|-----|
| Parameters  | Calcium (mg/100g) | Phosphorus (mg/100g) | Available lysine (g/16 g nitrogen) | Pepsin digestibility (%) | Calcium (mg/100g) | Phosphorus (mg/100g) | Available lysine (g/16 g nitrogen) | Pepsin digestibility (%) |
| Storage period (days) | 192.83 | 293.41 | 7.14 | 91.11 | 193.58 | 294.37 | 7.50 | 92.10 |
| | 191.87 | 291.95 | 6.97 | 90.29 | 192.56 | 292.70 | 7.18 | 91.45 |
| | 190.92 | 290.50 | 6.81 | 89.48 | 191.54 | 291.03 | 6.86 | 90.80 |
| | 187.93 | 286.31 | 4.97 | 88.60 | 188.01 | 288.15 | 5.68 | 89.51 |
Table 4 Changes in nutritional characteristics of hydrolysed meat (Lizard fish) powder incorporated cereal mix

| Fish meat powder | 10% | 15% | 20% | 25% |
|------------------|-----|-----|-----|-----|
| Parameters       | Calcium (mg/100g) | Phosphorus (mg/100g) | Available lysine (g/16 g nitrogen) | Pepsin digestibility (%) | Calcium (mg/100g) | Phosphorus (mg/100g) | Available lysine (g/16 g nitrogen) | Pepsin digestibility (%) |
| Storage period (days) | | | | |
| 0                | 194.03 | 293.49 | 6.40 | 88.57 | 197.85 | 294.55 | 6.68 | 89.64 |
| 30               | 193.38 | 291.25 | 6.29 | 88.46 | 197.21 | 292.51 | 6.44 | 89.26 |
| 60               | 192.75 | 289.01 | 6.18 | 88.36 | 196.58 | 290.47 | 6.20 | 88.89 |
| 90               | 190.10 | 287.80 | 4.27 | 87.50 | 192.81 | 289.20 | 5.11 | 87.69 |
| 20%              | Calcium (mg/100g) | Phosphorus (mg/100g) | Available lysine (g/16 g nitrogen) | Pepsin digestibility (%) | Calcium (mg/100g) | Phosphorus (mg/100g) | Available lysine (g/16 g nitrogen) | Pepsin digestibility (%) |
| 30               | 201.79 | 295.71 | 6.71 | 90.75 | 204.09 | 295.21 | 6.77 | 91.70 |
| 60               | 200.50 | 294.03 | 6.56 | 90.16 | 203.59 | 294.35 | 6.62 | 91.15 |
| 90               | 199.20 | 292.36 | 6.41 | 89.57 | 203.10 | 293.50 | 6.47 | 90.60 |
| 25%              | Calcium (mg/100g) | Phosphorus (mg/100g) | Available lysine (g/16 g nitrogen) | Pepsin digestibility (%) | Calcium (mg/100g) | Phosphorus (mg/100g) | Available lysine (g/16 g nitrogen) | Pepsin digestibility (%) |
| 30               | 197.26 | 290.48 | 5.21 | 88.80 | 201.15 | 291.10 | 5.46 | 89.48 |
Table.5 Changes in the functional characteristics of cooked meat (lizard fish) powder incorporated cereal mix

| Fish meat powder | 10% | 15% | 20% | 25% |
|------------------|-----|-----|-----|-----|
| Parameters       | WAC | FAC | WAC | FAC | WAC | FAC | WAC | FAC |
| Storage period (days) |     |     |     |     |     |     |     |     |
| 0                | 2.50 | 0.67 | 2.58 | 0.70 | 2.65 | 0.71 | 2.72 | 0.73 |
| 30               | 2.58 | 0.62 | 2.65 | 0.65 | 2.72 | 0.68 | 2.79 | 0.70 |
| 60               | 2.66 | 0.56 | 2.73 | 0.61 | 2.79 | 0.65 | 2.86 | 0.68 |
| 90               | 2.54 | 0.50 | 2.64 | 0.57 | 2.71 | 0.62 | 2.78 | 0.65 |

WAC – Water absorption capacity (g water/ g dried material)
FAC – F at absorption capacity (g oil / g dried material)

Table.6 Changes in the functional characteristics of hydrolysed meat (Lizard fish) powder incorporated cereal mix

| Fish meat powder | 10% | 15% | 20% | 25% |
|------------------|-----|-----|-----|-----|
| Parameters       | WAC | FAC | WAC | FAC | WAC | FAC | WAC | FAC |
| Storage period (days) |     |     |     |     |     |     |     |     |
| 0                | 2.62 | 0.69 | 2.69 | 0.72 | 2.75 | 0.75 | 2.84 | 0.78 |
| 30               | 2.70 | 0.66 | 2.77 | 0.69 | 2.83 | 0.73 | 2.95 | 0.76 |
| 60               | 2.78 | 0.63 | 2.85 | 0.67 | 2.92 | 0.71 | 3.00 | 0.73 |
| 90               | 2.70 | 0.60 | 2.74 | 0.64 | 2.80 | 0.68 | 2.87 | 0.71 |

WAC – Water absorption capacity (g water/ g dried material)
FAC – F at absorption capacity (g oil / g dried material)

Table.7 Changes in biochemical of cooked meat (Lizard Fish) incorporated powder cereal mix

| Fish meat powder | 10% | 15% | 20% | 25% |
|------------------|-----|-----|-----|-----|
| Parameters       | FFA | PV  | TVB-N | FFA | PV  | TVB-N | FFA | PV  | TVB-N | FFA | PV  | TVB-N |
| Storage period (days) |     |     |     |     |     |     |     |     |     |     |     |     |
| 0                | 0.04 | 0.37 | 1.55 | 0.04 | 0.35 | 3.18 | 0.04 | 0.32 | 4.81 | 0.03 | 0.29 | 6.45 |
| 30               | 0.05 | 0.51 | 3.79 | 0.05 | 0.49 | 5.35 | 0.05 | 0.46 | 6.96 | 0.04 | 0.41 | 8.10 |
| 60               | 0.06 | 0.65 | 6.04 | 0.06 | 0.63 | 7.51 | 0.06 | 0.59 | 9.12 | 0.05 | 0.52 | 9.75 |
| 90               | 0.08 | 0.82 | 10.36 | 0.07 | 0.78 | 13.01 | 0.07 | 0.77 | 14.97 | 0.07 | 0.70 | 16.58 |

FFA-Free Fatty Acid (% Oleic acid), PV-Peroxide Value (milli equivalent of O₂/kg of fat),
TVB-N - Total Volatile Base –Nitrogen (mg %).
Table 8 Changes in biochemical characteristics in hydrolysed meat (Lizard Fish) powder incorporated cereal mix

| Fish powder | 10% | 15% | 20% | 25% |
|-------------|-----|-----|-----|-----|
| Parameters  | FFA | PV  | TVB-N| FFA | PV  | TVB-N| FFA | PV  | TVB-N| FFA | PV  | TVB-N|
| Storage period (days) |     |     |     |     |     |     |     |     |     |     |     |     |
| 0           | 0.04| 0.16| 1.06| 0.04| 0.14| 2.30| 0.04| 0.13| 3.55| 0.03| 0.11| 5.16 |
| 30          | 0.05| 0.32| 2.61| 0.05| 0.30| 4.41| 0.04| 0.26| 6.10| 0.04| 0.24| 8.06 |
| 60          | 0.06| 0.47| 4.16| 0.06| 0.45| 6.53| 0.05| 0.40| 8.67| 0.05| 0.37| 10.97|
| 90          | 0.07| 0.66| 8.37| 0.07| 0.62| 11.27|0.06| 0.59| 14.75|0.06| 0.54| 17.79|

FFA-Free Fatty Acid (% Oleic acid), PV-Peroxide Value (milli equivalent of O₂/kg of fat), TVB-N - Total Volatile Base –Nitrogen (mg %).

The physico-chemical and functional properties of fish meat powder from Lizard fish meat prepared by both steam cooking and hydrolyzing process is given in Table 2. The protein content of fish powder from cooked and hydrolyzed meat powder was 89.63% and 88.61% respectively. Available lysine and pepsin digestibility of above powders were 9.94% and 9.62% respectively. The results of the present study are in agreement with previous workers (Setty et al., 1977). Calcium and phosphorus content of cooked meat powder were found to be 205.58 (mg/100g) and 287.54 (mg/100g) respectively, whereas in hydrolysed meat powder it was 250.06 and 296.37 (mg/100g) respectively. The values of TVB-N, FFA and PV were found to be 1.23 (mg %), 0.009 % of oleic acid and 0.08 milli equivalent O₂/kg of fat respectively in cooked meat powder, also as in hydrolysed meat powder it was found to be 1.19 mg%, 0.007 % of oleic acid and 0.07 milli equivalent O₂/kg of fat respectively. TVB-N, FFA and PV values of hydrolysed meat powder were less than cooked meat powder, it may be due to hydrolysis process. The values of TVB-N, FFA and PV in the present study were less than the result reported by chattopadhyay et al., (2004) in edible meat from Silverbellies. During storage period proximate composition did not vary significantly in both cooked as well as hydrolysed meat powder incorporated with cereals at different percentage. However protein content increased with increase in amount of fish powder similarly carbohydrate value was decreased. The highest protein content (34.2%) was found in 25% cooked fish powder incorporated mix, where as it was 29.60% in hydrolysed meat powder incorporated mix. The results for changes in nutritional characteristics of both health mix are presented Table 3 and 4. The values of available lysine and pepsin digestibility were found to increase with increasing amount of fish powder incorporation. The highest value of available lysine (7.50 g/16gN₂) and pepsin digestibility (92.1%) were found in 25% cooked meat powder incorporated mix, whereas in hydrolysed meat powder incorporated mix it was 6.77 (g/10g nitrogen) and 91.70% respectively. There is significant difference (P<0.05) found in the nutritional characteristics of health mix. The value of calcium and phosphorus are also increases with increasing amount of fish powder incorporation. During storage slight reduction in the value of available lysine and pepsin digestibility were observed. Similar trend were observed by Rehman (2006) in cereals. The results for changes in functional properties of health mix are presented in Table 5 and 6. The functional properties such as WAC and FAC were found to be
increasing trend with increasing amount of fish powder added. During storage as slight increase in WAC were found. This is may be due to fact that denatured proteins bind more water through exposure of the interior hydrophilic groups (Kinsella, 1982). The results for changes in biochemical characteristics are presented in Table 7 and 8. The value of TVB-N, PV, and FFA were increased during storage period. FFA and TVB-N and PV content vary significantly (P<0.05) during storage period in cooked meat powder incorporated mix. FFA content did not vary significantly during storage period in hydrolysed meat powder incorporated mix whereas PV and TVB-N did vary at 1% and 5% respectively.

Initial TPC value was 3.8 x 10^3 cfu/g and after 90 days it was 1.9X10^3 cfu/g in cooked meat powder incorporated mix, and it was 4.0X10^3 cfu/g and after 90 days 2.0X10^3 cfu/g in hydrolysed meat powder incorporated mix respectively. Reduction in the TPC is mainly due to low water activity. Salmonella, V. cholerae and E. coli were absent throughout the storage period. Health drink was prepared by mixing 10-15g of mix in required amount of hot water with sugar and milk powder. Organoleptic quality revealed that the tastes of the liquid drinks prepared were sweet in taste and no fishy odour immediately after its preparation for different study period. However there is significant difference (p<0.01) observed in their overall acceptability.

The drink had no fishy odour and sweet in taste. Drink prepared from hydrolyzed meat powder – cereal mixture was more acceptable than it is prepared using cooked fish meat powder – cereal mixture. Compare to four different ratios tried 10% hydrolyzed meat powder – cereal mixture shows better organoleptic acceptability throughout the study.

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