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Utilization of Low Priced Fish for Preparation of Noodles

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Abstract

The present investigation aimed at utilization of deep sea fish species *viz.,* reef cod (*Epinephelus dicanthus*), locally called murami for the preparation of noodles. The fish was subjected to mechanical deboning to collect minced meat which was incorporated in noodles at levels 5, 10, 15, 20, 25 and 30%. Noodles without fish mince was kept as control and quality of the prepared noodles were determined. Out of these three samples namely one batch of control and two batches of fish noodles with 15 and 20% fish mince were packed in retortable pouch. Effect of different levels of reef cod mince on the sensory quality like appearance, color, odour, taste, texture, firmness, chewiness, cooking characteristics like cooking time, cooking loss, swelling index, water absorption, color and proximate composition were evaluated. With regard to thickness, the control was thinner than fish noodles. The noodle strands were smooth in batches 5 to 20% and hence required less time for cooking compared to control whereas noodles with 25% and 30% mince needed longer cooking time. The swelling indices were lower in fish noodles compared to control with the exception of sample with 5 and 25% mince. The cooking loss increased in fish noodles compared to control noodles. The water absorption capacity of fish noodles was found to be lower than that of control as indicated by a decrease in the L* value. Addition of mince appeared to have no significant effect on the yellowness of the noodles. The protein content increased significantly with the increase in the percentage of fish mince, but this increase was not proportional which can be attributed to the variation in moisture content of noodles. With regard to sensory quality, the control was superior. Firmness and chewiness showed lower values at higher fish mince levels.

Keywords: Reef cod, noodles, minced meat, sensory quality, proximate composition

Introduction

Hunger and nutrition remain the most devastating problems faced by the present society and fisheries contributes significantly towards food security in supplying nutrition and easily digestible food. In this direction, efforts were made to utilize a deep sea fish species namely *Epinephelus diacanthus* in the form of mince for the preparation of noodles. Noodles, having its origin in China dating back to Han dynasty (206 BC - 220 AD), is one of the most popular and oldest forms of processed foods consumed in Asia. Since protein calorie deficiency malnutrition is still prevalent among millions of preschool children below the age of five, there is a need for fortification of noodles by incorporating fish mince which will improve the organoleptic properties, nutritional values, palatability and consumption. Food enrichment is defined as addition of nutrients to food in common use to enhance their nutritive value (FAO, 1995). The food used for fortification need to be consumed regularly by target population, in this context. Noodles appears to be suitable means for fortification and fish mince an ideal fortificant as both serves to be highly acceptable to children. Better shelf stability at room temperature, low cost, simple production process are added advantages of noodles. The present investigation aimed at incorporating fish mince from the underutilized fish species of low economic value for the preparation of noodles and their further quality studies.

Materials and Methods

Fresh reef cod *viz., Epinephelus diacanthus* caught by multiday fishing operation off Mangalore were used

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for the study. The meat was separated using meat picking/deboning machine (Model- SG/S-6 "CAN mark" power driven reciprocatory type, supplied by Toyo Seikan Kaisha Ltd. Japan with disk having 6.5 mm perforations) and the detached meat was minced and used for the preparation of noodles. Two brands of Maida (Moti and R.K.) were used for noodle preparation. All the chemicals used for the present study were either AR or GR obtained from B.D.H. India / Merck / Ranbaxy laboratory. The various ingredients used to prepare noodles such as salt, MSG, spices, vegetables oil were obtained from the local market. The retortable pouches used for the study were procured from M.H. Packaging, Ahmedabad. The composition of the retort pouch used was plain polyester (12.5 micron) laminated with aluminum foil (12.5 micron) and further laminated with cast polypropylene (80 micron) having a size of 17 x 15.5 cm. with total thickness of 420 gauges.

Noodle equipment used for preparation of noodles included dough mixer, sheeting and slitting machine, steaming vessel and drying trays. The experiment was conducted in a commercial noodle unit, all the equipment were procured from Kolkata except the vessels used for steaming and the oven drying, which were fabricated locally. The dry noodles were packed in LDPE of 200 gauge and were sealed using an electrical sealer. The over pressure retort used for sterilizing the product was supplied by John Frazer and sons Ltd. New castle, UK. An impulse heat scaling machine supplied by Sevana Electrical Appliance Ltd. Kerala, India was used for sealing the product in retortable pouches. The thermal process evaluation of the product was conducted using an Ellab CTF 84 data recorder with printer. The color of the noodle samples was estimated using Hunter's Miniscan colorimeter supplied by Hunter Associates Laboratory, Virginia, USA with Xenon light (D65) of average intensity of 1 moonlight. The general equipment used for analysis include homogenizer, balances, hot air oven, muffle furnace, water bath, nitrogen digestion, distillation assembly, in addition to the other utilities such as steel vessels for boiling, enamel plates for stirring, electrically operated mixer grinder, chopping boards, steel knives etc.

Preparation of Noodles involves mixing of Maida & fish mince with water, salt and MSG. Further steps involve Resting (30 min.) $\longrightarrow$ compounding (with 4-6 steps of sheeting) $\longrightarrow$ slitting $\longrightarrow$ waving $\longrightarrow$ weighing $\longrightarrow$ steaming (1 h) $\longrightarrow$ sun drying (6-7 h) $\longrightarrow$ packing in LDPE packs. The physical characteristics of whole reef cod were determined by measuring the total length, standard length and weight at random.

The proximate composition was estimated and expressed for fish, maida and noodles on wet weight & dry weight basis as per AOAC (1995) and values were expressed as percentage, the moisture was estimated by standard hot air oven (maintained at 105 +/- 2^{o}C), the crude protein content was determined by Micro Kjeldahl method and the ash content was measured in muffle furnace (temperature 600 +/- 50^{o}C for 4 to 6 h). Total lipid content was estimated by the method described by Bligh & Dyer (1959).

Total volatile based nitrogen (TVB-N) in the fish mince was estimated by the method described by Beatty & Gibbons (1937). TMA-N was estimated by Conway micro diffusion method (Conway, 1947), α-amino-N2 (AAN) was estimated by the method of Pope & Stevens (1939). The free fatty acids (FFA) were estimated by the improved titrimetric method of Tarr (1947). Peroxide value (PV) was determined from the lipid extract according to Tarr (1947) iodometrically.

The width and the thickness of noodles strands were measured using screw gauge. The method described by Dexter et al. (1983) was used for estimating cooking time while water absorption, cooking loss and swelling index was estimated using the method described Oh et al. (1985). For each of the cooking test 10 determinations were made and mean values were taken. The sensory valuation of fresh fish was performed using Quality Index Method (Bremmer & Hallett, 1985) and for cooked fish a 10 point scale was used. The sensory qualities of cooked noodles containing different percentage of fish mince were assessed by method described by Kramer & Twigg (1970).

Noodle color was estimated by using powdered noodles after calibrating the instrument to display L*, a*, and b*expressed in CIE Lab value. During estimation the samples were covered to prevent interference of light. The protein enrichment percentage of fish noodles was calculated and the ratio of dry weight of fish protein to the sum of fish protein & flour protein. The procedure was conducted as described by Madhushweta Das (1989).

Heat penetration studies for control noodles and fish noodles containing 15% and 20% mince were carried out by inserting thermocouples to the pouches. The thermocouples were fixed in the geometrical center and the pouches were filled with RTE (ready to eat) noodles. The pouches were vacuum sealed and kept horizontally in the retort. The thermal process was carried out at temperature 121.10°C and various parameters such as retort temperature, product temperature and F_0 value were obtained during the entire processing duration at one minute interval The result of the sensory analysis of cooked noodles, ready to eat noodles with and without retortable pouch were analyzed statistically using ANOVA (Snedecor, 1956).

Result and Discussions

The proximate composition of mince presented in Table 1 is calculated on wet and dry weight basis which shows mince is a good source of protein as protein percentage is increasing gradually in all samples. The chemical composition of two brand of commercial maida was analyzed and the results are given in Table 2. The variation in the quality with reference to protein and lipid content was also observed between the brands.

The breadth of the noodles stand is represented by width and size is represented by thickness as given in Table 3. It was found that addition of fish mince has increased the width slightly when compare to the control except for 15%. The quantity of fish mince added appears to have no significant effect on width and thickness.

The cooking time, swelling index, cooking loss and water absorption of the control and fish noodles (Table 4) indicated the effect of addition of mince at various levels on cooking behavior of noodles. The fish noodles with mince levels 5, 10, 15 and 20% required less time for cooking compared to control whereas 25 and 30% mince levels needed longer cooking time. The values are comparable to cooking time reported by Dexter et al. (1981), Oh et al. (1985) and Madhusweta Das & Chattoraj (1989).

The swelling indices were lower in fish noodles compare to control with an exception of 5% mince and 25% mince. Cooking loss was higher in fish noodles than control. But the results of Madhusweta Das & Chattoraj (1989) in fish protein enriched noodles showed lower cook loss which is due to the denaturation of protein at higher temperature. The higher cook loss in the present study may be due

Table 1. Characteristics of Fresh Reef Cod Mince

Table 1.A. Proximate composition of reef cod mince used for noodles

Proximate composition of mince %	Wet weight Basis	Dry weight Basis
Moisture	79.97 ± 0.1*	-
Protein	17.61 ± 0.049 *	87.7 ± 0.049*
Lipid	1.46 ± 0.002*	7.3 ± 0.002*
Ash	1.10 ± 0.018*	4.40 ± 0.018*

Table 1B. Biochemical characteristics of reef cod mince used for noodles

A: Nitrogenous compound	
TVB-N (mg%)	5.5±0.02*
TMA-N (mg%)	0.73±0.02*
A Amino-N_2 (mg%)	0.227 ± 0.1*
B: Lipid Quality	
FFA (% of Oleic acid)	23.0±1.02*
P.V. (mEq/kg)	9.6±089*

Table 2. Proximate composition of maida used for used for noodles preparation

Constituents	1 (R.K. brand)	2 (Moti brand)
Crude Protein %	12.550	14.40
Moisture %	10.70	11.10
Total Lipid %	0.80	1.21
Ash 5	1.60	1.10
Crude fibre %	0.10	0.10
Carbohydrate (by difference)	75.30	72.10

Table 3. Measurement of noodles

	Levels of Fish Mince samples	Width (mm)*	Thickness (mm)*
1.	0%	1.652	0.980
2.	5%	1.780	1.356
3.	10%	1.742	1.054
4.	15%	1.608	1.152
5.	20%	1.686	1.116
6.	25%	1.882	1.054
7.	30%	1.728	1.226

*Average of five readings

Table 4. Cooking characteristics of noodles

Samples	Levels of fish mince	Cooking time (Min)	Swelling Index (unit)	Loss of Solids %	Water Absorption gm/gm
1	0% (Control)	14	3.6	7.7	2.7
2	5%	8	4.0	10.3	2.3
3	10%	10	3.5	8.0	2.3
4	15%	12	3.5	8.4	2.5
5	20%	13	3.2	8.7	2.3
6	25%	15	3.7	10.8	2.6
7	30%	16	3.6	13.6	2.6

Each value is a mean of 10 readings n=3

to the use of fish mince which contains more water soluble proteins.

Water absorption was found to be lower than that of control. Therefore, it is concluded that the amount of water absorbed decreases with protein enrichment which is similar to the reported by Yang et al. (1983). In this study all noodles sample has displayed optimum cooking behavior (white colour, cooking time & loss, sticky nature) indicating no deleterious effect due to the addition of fish mince on the cooking quality.

Color of noodle is one of the most important quality attributes determining its acceptability. Instrumental color determination of noodle was performed 10 days after noodle preparation (Table 5). In general, the L* values for fish noodles were lower than control, clearly indicating that the addition of fish reduced the whiteness. The control sample had highest L* value (86.86) while the fish noodles with

Table 5. Noodle Colour

Samples	L*	a*	b*
1.	86.86	0.955	12.33
2.	85.21	0.825	14.3
3.	84.93	0.78	14.61
4.	83.35	1.25	15.84
5.	84.08	0.81	16.36
6.	82.02	1.01	16.1
7.	84.864	0.345	14.4

L* towards 100 - perfect white
towards 0 - perfect black
a*:+ ve - towards red
- ve - towards green
b*:+ve - towards yellowish
- ve - towards bluish
Each value is a mean of triplicate

Table 6a. Sensory analysis of freshly prepared noodles

Attributes Sample	Appearance	Colour	Odour	Taste	Texture	Overall Quality
Control	8.5 (0.2)	8.5 (0.3)	8.8 (0.62)	8.2 (0.02)	8.2 (0.02)	8.7 (0.02)
5%	8.4 (0.22)	8.1 (0.6)	8.6 (0.8)	8.4 (0.06)	8.1 (0.31)	8.3 (0.04)
10%	8.15 (0.3)	7.8 (0.02)	8.0 (0.9)	7.9 (0.03)	7.6 (0.25)	7.7 (0.06)
15%	8.4 (0.4)	8.2 (0.13)	8.1 (0.9)	8.1 (0.2)	8.2 (0.06)	8.1 (0.07)
20%	8.2 (0.06)	8.0 (0.02)	8.5 (0.5)	8.3 (0.02)	8.3 (0.09)	8.6 (0.09)
25%	7.9 (0.09)	7.7 (0.05)	7.7 (0.2)	7.5 (0.06)	7.4 (0.08)	7.4 (0.13)
30%	7.9 (0.04)	7.4 (0.5)	7.5 (0.3)	7.2 (0.15)	7.3 (0.05)	7.4 (0.14)

Each value is a mean of 10 replicates (N=10), rated on a 9- point scale
Values in parenthesis represent standard deviation

Samples Attributes	Control	5%	10%	15%	20%	25%	30%
Firmnes	3.4 (0.2)	2.9 (0.01)	2.9 (0.2)	3.3 (0.03)	3.4 (0.02)	2.2 (0.01)	2.2 (0.05)
Chewiness	3.5 (0.3)	3.2 (0.02)	2.7 (0.01)	2.4 (0.02)	3.4 (0.05)	2.3 (0.03)	2.3 (0.01)

Each value is a mean of 10 replicates (n=10), rated on a 4- point scale.
Values in parenthesis represent standard deviation

Table 6b. Sensory analysis of noodles stored for 3 months

Attributes Sample	Appearance	Color	Odour	Taste	Texture	Overall Quality
Control	8.3 (0.03)	8.5 (0.02)	8.6 (0.03)	8.2 (0.02)	8.2 (0.14)	8.7 (.06)
5%	8.2 (0.02)	8.0 (0.02)	7.2 (0.17)	8.0 (0.04)	7.8 (0.02)	7.5 (0.26)
10%	8.0 (0.02)	7.2 (0.06)	7.6 (0.08)	7.1 (0.04	7.3 (0.04)	7.3 (0.3)
15%	8.4 (0.02)	8.0 (0.07)	7.5 (0.03)	7.7 (0.06)	7.9 (0.02)	8.0 (0.04)
20%	8.02 (0.06)	8.1 (0.05)	8.0 (0.09)	8.4 (0.52)	8.2 (0.02)	7.8 (0.05)
25%	7.8 (0.02)	7.2 (0.02)	7.4 (0.06)	7.1 (0.06)	7.0 (0.06)	7.0 (0.06)
30%	7.7 (0.12)	7.3 (0.13)	7.2 (0.02)	6.8 (0.09)	6.8 (0.05)	6.8 (0.08)

Each value is a mean of 11 replicates (n=10), Rated on a9 point scale
Values in parenthesis represent standard deviation

Sample Attributes	Control	5%	10%	15%	20%	25%	30%
Firmness	3.5 (0.02)	3.2 (0.01)	3.0 (0.01)	3.5 (0.05)	3.9 (0.03)	2.7 (0.01)	2.8 (0.04)
Chewiness	3.4 (0.01)	2.9 (0.02)	2.9 (0.01)	3.5 (0.04)	3.6 (0.04)	2.5 (0.01)	2.6 (0.03)

Each value is a mean of 11 replicates (n=10), Rated on a 4 point scale.
Values in parenthesis represent standard deviation

25% fish mince had the lowest L* value (82.02). The a* values of fish noodles appears to have no significant effect of the yellowishness of the noodles. The B* values of fish noodles showed significant effect of the color quality of noodles with the increase in fish levels.

The result of sensory analysis of freshly prepared noodles was conducted by cooking the noodle samples in 2% salt solution. The results are given in Table 6a and the data after 3 month storage is given in Table 6b. The results clearly indicated the superiority of control noodles with regards to all the sensory attributes including firmness and chewiness. The panelists clearly distinguished the fish noodles from the control noodles but were not able to identify the relative increase in mince level up to 20%. The fish odor was prominent for the samples containing 25% and 30% fish mince. Similarly, the firmness and chewiness which are the important textural attributes of cooked noodles showed lower values at higher fish mince levels. The results of sensory evaluation of stored noodles at the end of three month period showed similar trend of acceptability.

The proximate composition (Table 7a) of freshly prepared noodles indicated that the moisture content varied between 5.6 and 9.3 and the lipid between 0.74% and 1.45%. The ash content varied between 1 and 1.6%. The most significant difference was seen in the protein content. The control noodles had least protein content of 12.75% and the fish noodles with 30% mince had 20.49% protein. This clearly showed the advantage of fish mince for fortification. The changes in the proximate composition of noodles during storage in 3 batches namely control noodle and fish noodles with 15 and 20% fish mince is given in (Table 7b).

Table 7a. Proximate composition of noodles

Samples	Moisture (%)	Protein (%)	Lipid (%)	Ash (%)
Control	5.60	12.71	1.67	1.0
5%	5.81	13.11	0.85	1.2
10%	6.70	14.12	0.74	1.2
15%	5.93	15.83	0.85	1.4
20%	9.31	16.34	1.05	1.2
25%	7.90	17.41	1.20	1.6
30%	8.10	20.49	1.45	1.6

It was interesting to note that there was gradual increase of protein content in all the samples. The percentage enrichment was calculated as per the formula given by Madhusweta Das & Chattoraj (1989). The percentage increase in protein enrichment depends on ratio of fish protein and floor protein to that of sum of fish protein and floor protein expressed as percentage (Table 8).

$$\text{Protein enrichment Percentage} = \frac{\text{Protein derived from fish mince}}{\text{Protein derived from mince + Protein derived from maida}}$$

The control noodles and fish noodles containing 15 and 20% were packed in retortable pouch and subjected to thermal process. In the present investigation, the retort and product temperature was recorded every minute and the data was presented at an interval of 2 min. The retort come up time (CUT) was 11 min and steam off time was 33 min. The retort temperature 121.1°C was attained in 11 min. The retort time and F_0 value attained was around 9 (Table 9). The derivation of heat penetration parameters was obtained by plotting the time temperature sequence (Fig. 1 A, B, C). The temperature of the heating medium increases the rate of heat penetration. The two way ANOVA results to find out the significant difference between each of the attributes within the sample and between the batches for freshly prepared cooked noodles, for RTE noodles and for RTE noodles in retortable pouch reveals that all the sensory attributes significantly differ both within the sample and also between the batches. The firmness and chewiness didn't show significant variation within the sample and between the batches. The results were similar for RTE seasoned noodles. The noodles packed in retortable pouch distinctly differed in each of the attribute both within the sample and between the batches.

Table 7b. Proximate composition of stored noodles

Proximate Composition	Moisture			Protein			Lipid			Ash		
	Control	15%	20%	Control	15%	20%	Control	15%	20%	Control	15%	20%
0 Day	5.6	5.93	9.31	12.71	15.83	15.21	1.67	0.85	1.06	1.0	1.4	1.2
30 Days	4.1	4.2	7.8	13.69	16.12	15.81	2.1	0.89	1.1	1.1	1.3	1.2
60 Days	3.7	3.9	6.2	14.38	17.39	16.01	2.0	1.10	1.31	1.0	1.2	1.3
90 Days	1.42	2.86	3.04	15.42	17.5	16.82	2.3	1.39	1.61	1.1	1.4	1.4

The present study suggested the supplementation of fish mince in cereal noodles to enrich a popular breakfast diet as source of high-quality protein. The mince of under-utilized and low-priced fish reef cod (*Epinephelus dicanthus*) were found to be acceptable with 15 to 20% fish mince for ready to eat seasoned noodles without affecting the sensory quality. The fish odor was prominent for the samples containing 25% and 30% fish mince. The seasoned noodles can be stored at room temperature for more than 3 months without any adverse changes. The firmness and chewiness which are the important textural attributes of cooked noodles showed lower values at higher fish mince levels.

References

AOAC (1995) Official methods of analysis of AOAC International, Vol. II, 16th edn., Conniff, P. (Eds.). Association of Official Analytical Chemists International, Virginia, USA, p 39

Beatty, S.A. and Gibbons, N.E. (1937) Measurement of spoilage in fish. J. Bio. Bd. Can. 3: 77-91

Bligh, E.G. and Dyer, W.J. (1959) A rapid method of lipid extraction and purification. Can. J. Biochem. Physiol. 37(8): 911-917

Bremmer, H.A. and Hallett, I.C. (1985) Muscle fibre connective tissue junctions in the blue grenadier (Macrusonus novaezs elandiae). A scanning electron microscope study. J. Food Sci. 50: 975-980

Conway, E.J. (1947) In microdiffusion analysis. Revised Edn. L. van Nostrand Co. Inc., New York

Dexter, J.E. Matsuo, R.R. and Morgan, B.C. (1983) Spaghetti stickiness: some factors influencing stickiness and relationship to other cooking quality characteristics. J. Food Sci. 48: 1545

Dexter J.E. Matsuo, R.R. and Morgan, B.C. (1981) High temperature drying: Effect on spaghetti properties. J. Fd Sci. 46: 1741

FAO (1995) Food fortification, technology and quality control. Report on a FAO Technical meeting, Rome, Italy. Food and Nutrition paper. 60

Kramer, A. and Twigg, B. A. (1970) Quality control for the food industry, Vol. I. 3rd edn., Fundamental, AVI Pub. Co., Connecticut

Madhusweta Das and Chattoraj, D.K. (1989) Quality characteristics of noodles enriched with salt extracted fish protein. J. Fd. Sci. Technol. 26(5): 272-276

Madhusweta Das (1989) Studies on physicochemical aspects of myosin and preparation of myosin enriched foods. Ph.D. Thesis Jadavpur University, Calcutta

Oh, N.H., Seib, P.A., Deyoe, C.W. and Ward, A.B. (1985a) Noodles-Ii. The surface firmness of cooked noodles from soft and hard wheat flours. Cereal Chem. 62, 431

Oh, N.H., Seib, P.A. and Chung, D.S. (1985b) Noodles-III Effects of processing variables on quality characteristics of dry noodles. Cereal Chem. 62: 437-440

Oh, N.H., Seib, R.A., Word, A.B. and Deyoe, C.W. (1985c) Noodles-IV. Influence of flour protein, extraction rate, particle size and starch damage on the quality characteristic of dry noodles. Cereal Chem. 62: 441

Pope, C.G. and Stevens, M.F. (1939) The determination of amino nitrogen using a copper method. Biochem. J. 33: 1070-1077

Snedecor, G.W. (1956) Statistical method. 5th edn., Iowa State College Press, Iowa State College, Ames. Iowa. 534 p

Tarr, H.L.A. (1947) Control of rancidity in the fish flesh. I. Chemical oxidants. J. Fish. Res. Board, Canada. 7: 135-154

Yang, H.C., Yang, B.H. and Lim, M.H. (1983) Studies on the preparation and utilization of file fish protein concentrate (FPC) III. The preparation and characteristics of dried noodles using FPC wheat composite flour. Korean J. Fd. Sci. Technol. 15: 262