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Meat recovery and biochemical, sensory properties of fish products under different processing practices

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ABSTRACT

The aim of present study was to observe meat recovery of common carp (*Cyprinus carpio*) by hand picking and mechanical de-boning. Proximate composition, chemical and sensory properties of the product of meat and products were also evaluated. Meat recovery from hand picking and mechanical de-boning was 38.05% ±0.949 and 37.52% ±1.057 (Mean ±SE), respectively. Moisture content was recorded significantly high (78.22%± 0.655) in fish flesh. Crude protein in flesh along with nugget prepared from the meat recovered under both processes was recorded significantly ($P<0.05$) high, while crude fat and ash content were observed significantly ($P<0.05$) high in cutlet. No significant difference was recorded in nugget prepared from hand picked and mechanical de-boned meat prepared. Similar observations were also noted in cutlet. No major fluctuation was recorded in pH, TBARS and Peroxide value of flesh, nugget and cutlet. Sensory evaluation of products were done for appearance, crispiness, juiciness, texture, flavour, and overall acceptability for likings on nine point Hedonic Scale. Through 'panellist score card' it was observed that all the products fall in the category of 'liked moderately' or above and fish cutlets prepared from hand picked meat scored maximum for overall acceptability.

Key words : *Common carp, Cyprinus carpio, Meat recovery, Biochemical properties, Fish products, Sensory evaluation*

Introduction

Fish is a good source of protein and consumed all over the world in fresh and processed form. Demand for fish and fishery products is increasing due to population growth, increase in the disposable income and in the relative preference compared with other foods (Taskaya *et al.*, 2003). During 2011-12 India was second largest producer of fish (8.67 MT) in the world, having inland production of 5.30 MT (Government of India, 2013). Carps are one of the most widely cultured species in fresh water, due to fast growth rate, easy cultivation and high feed efficiency ratio (Ozlem, 2011). Recovery of edible portion from fish chiefly depends on species, size, body shape, feeding habit, migration, sex, maturity stage and processing methodology. Meat recovery related to whole weight has a significant impact on processors profit and trait of interest (Bosworth, 2004). Value addition is one of the possible ways of effective utilization of fish by achieving increased shelf life and demand. Proximate composition often changes in accordance to the processing method and value addition, the chemical properties such as pH, TBARS, peroxide value also changes. Change in the chemical properties alters its sensory properties (Nishimoto *et al.* 1985 and Shah *et al.* 1999). Fish products introduced into staple food adds nutri-

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tional value, improve appetite and reduces spoilage and wastage (Okereke, 2011). Nature of diet and environment affects the sensory attributes of fish meat in terms of colour, texture, smell, flavour and appearance (Grigorakis, *et al.*, 2003). Keeping in view the above facts, the present experiment was designed to evaluate minced meat recovery of common carp (*Cyprinus carpio*) through hand picking and mechanical method, biochemical properties (moisture, crude protein, crude fat, ash, pH, TBARS and peroxidise value) and sensory evaluation of the products (fish nugget and cutlet).

Materials and Methods

Fresh common carp (*Cyprinus carpio*) was obtained from Fish Farm of College of Fisheries, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana, Punjab (INDIA). Fish was divided into two groups one for hand picking of meat and other for mechanical de-boning. For hand picking meat, fish was dressed and meat was removed with the help of forceps and knife, For mechanical de-boning, after removing head, visceral organs, fish was split laterally into two equal parts and was passed through 5mm diameter perforated stainless steel drum, of 20.5cm diameter, powered by 5HP three phase motor. To avoid meat loss in holes of drum, some of the fish fillets were passed before the processing of actual samples, just to fill pores present in drum. Minced meat recovery was expressed in terms of percentage recovery, by calculating as per formula given below

$$\text{Minced Meat Recovery (\%)} = \frac{\text{Weight of Minced Meat (g)}}{\text{Total Fish Weight (g)}} \times 100$$

Meat obtained by both the methods was packed in 250µ HDPE bag, separately and kept at -20°C and was further used to prepare fish nugget and cutlet and products were analysed for proximate composition (moisture, crude protein, crude fat and ash) and chemical properties (pH, TBARS and peroxidise value). Products after cooking were served to panellist for sensory evaluation.

Preparation of Fish Products

For the present study, minced meat recovered by two methods (hand picked and mechanical deboned meat) were used to prepare fish products i.e. fish nugget and cutlet, separately, by mixing spices and other ingredients (Table 1). For nugget preparation, after adding ingredients, it was mixed well and then mixture was spread as a layer over well greased 250µ HDPE sheet of 1.0 cm thickness and were kept in deep freezer (-20±2°C). After 16-18hrs, tray was takenout and frozen slab was cut in 3×3×1cm size. For cutlets, vegetables were fried in soybean oil and then spices, boiled potato, vinegar, salt and boiled meat were added. After cooling, mixture was given oval shape (25g). All these products were battered and breaded and packed in 250µ HDPE bags and stored at -20±2°C in deep freezer.

Table 1. Composition of ingredients of fish products

Ingredients	Products	
	Fish Nuggets	Fish Cutlets
Minced Meat (g)	1000	1000
Boiled Potato (g)		500
Corn Starch (g)	50	50
Vinegar (ml)	25	25
Salt (g)	15	25
Cumin Powder (g)	2.5	2.0
Black Pepper (g)	2.0	2.0
Red Chillies (g)		2.0
Turmeric Powder (g)		1.0
Soybean oil (ml)		75
Vegetables (g)		165*

*includes green chillies 15g, garlic 25g, ginger 25g and onion 100g

Ingredients for batter

Gram Flour (g)	150
Refined all purpose wheat flour (g)	50
Corn Starch (g)	25
Salt (g)	4.0
Water (ml)	400

*Bread Crumb is use for breading material

Biochemical properties

Biochemical properties were studied to evaluate proximate composition and chemical properties of flesh and product prepared from meat under different processing practices.

Proximate composition: Moisture, crude protein, crude fat and ash were determined as per the method of AOAC (2000). Crude protein was estimated by block digestion method for which Nitrogen was quantified as in percentage and N% was multiplied by 6.25.

Chemical properties: Fish flesh and product were

analysed for pH, TBARS and Peroxide value as per standard methods mentioned below

pH: The pH was determined with digital pH meter as per method described by Trout *et al.*, 1992.

Thiobarbituric acid reacting substances (TBARS) value: TBARS was determined spectrophotometrically using according to the method described by Witte *et al.*, 1970 and calculated as mg malonaldehyde per kg of sample by multiplying O.D. value with K factor of 5.2.

Peroxide value: Peroxide value was estimated by Koniecko (1979). Prepared sample was titrated with 0.1N sodium thiosulphate and calculated as meq/kg.

Sensory evaluation

At the time of sensory evaluation, products were taken out from deep freezer and after thawing products were cooked in pre-heated deep fat fryer at 180-190°C for 6-8min. in soybean oil, till colour turns golden brown.

A panel of 9 evaluators was constituted and a score card was prepared (Table 2) by using a nine point Hedonic Scale as per likings suggested by Popper *et al.*, (2004). Score card was provided to each panellist for sensory evaluation of all the products, separately. After evaluation of one product, evaluators were asked to rinse their mouth to maintain sensitivity for next product. At a time, single product of different processed meat was served to them. All products were evaluated by evaluators on the basis of appearance, crispiness, juiciness, texture, flavour and overall acceptability.

Table 2. Score card used for sensory evaluation of products on the basis of liking (as per suggested by Popper *et al.*, 2004)

Liking (nine point)	Scale points
Like extremely	- 9
Like very much	- 8
Like moderately	- 7
Like slightly	- 6
Neither like nor dislike	- 5
Dislike slightly	- 4
Dislike moderately	- 3
Dislike very much	- 2
Dislike extremely	- 1

Statistical analysis

For evaluating minced meat recovery through hand picking and de-boning machine, SPSS 16.0 statistical package was used. Proximate composition and sensory evaluation data was analysed by Duncan -t-test under SPSS 16.0 by one way ANOVA. The results were expressed as Mean ±Standard Error (SE) along with statistical differences. For chemical properties, average values of triplicate observations were taken.

Result and discussion

Recovery of meat is important commercial trait for successful operation of a processing unit. Variation in meat recovery depends on various characteristics including species, sex, season along with body shape, feeding habit, migration, maturity stage and processing methodology. In the present study, minced meat recovery by hand picking and through mechanical de-boner was 38.05% and 37.52%, respectively, which was non-significant ($P<0.05$) (Table 3). Vanitha *et al.* (2013) also recorded 35 – 40% recovery of minced meat yield of *Catla catla*, which also belongs to carp group.

For biochemical properties, proximate composition of flesh and products of hand and mechanical de-boned meat were analysed (Table 4). Moisture content was recorded significantly high in flesh (78.22%) and low in cutlet (63.07 and 62.06%, in hand picked and mechanically de-boned meat, respectively). Crude protein content was recorded significantly low in fish cutlet (11.75 and 11.94%, in hand picked and mechanically de-boned meat, respectively) while it was recorded highest in flesh (15.24%). Crude fat and ash content was recorded significantly ($P<0.05$) high in fish cutlet compared to

Table 3. Meat recovery under hand picking and mechanical de-boning (Mean ±SE)

Method	Average weight of fish (g)	Average weight of minced meat recovery (g)	Minced meat recovery (%)
Hand Picking	544.33 ±67.666[a]	204.88 ±23.598[a]	38.05 ±0.949[a]
Mechanical Deboning	497.88 ±41.891[a]	187.66 ±20.277[a]	37.52 ±1.057[a]

a = different degree of variance at $p<0.05$

Table 4. Proximate composition of flesh and products

Product Parameters	Flesh	Fish Nugget		Fish cutlet	
		Hand Pick Meat	Mech. De-boned meat	Hand Pick Meat	Mech. De-boned meat
Moisture (%)	78.22±0.655 [c]	74.20±1.220 [b]	72.35±1.077 [b]	63.07±0.446 [a]	62.06±0.683 [a]
Crude Protein (%)	15.24±0.537 [b]	13.62±0.252 [b]	13.91±0.542 [b]	9.94±0.075 [a]	9.16±0.768 [a]
Crude Fat (%)	3.49±0.277 [a]	2.98±0.335 [a]	2.61±0.235 [a]	11.75±2.50 [b]	11.940±0.504 [b]
Ash (%)	2.543±0.237 [a]	3.16±0.358 [a]	3.040±0.468 [a]	4.320±0.201 [b]	5.293±0.419 [b]

*Each value is represented as the mean ±SE

**Means followed by the same superscript within a row are not significantly different (P<0.05)

flesh and nuggets. No significant (P<0.05) difference among the single type of product prepared from different processed meat was recorded in the present study. The variation in proximate composition among products and flesh may be due to mixing of different non fish ingredients and variation product preparation procedure against natural orientation of flesh.

The chemical properties of flesh and products were estimated for pH, TBARS and peroxide value (Fig. 1). pH of flesh and product were recorded towards acidic in nature. pH value of flesh was recorded 6.48 while products were more acidic than flesh. TBARS value was comparatively less in flesh (0.48 mg MDA/kg), while in cutlets was high among the different products studied. Peroxide value in flesh was 0.53 meq/kg, in hand pick meat nugget 0.49 meq/kg, mechanical de-boned meat nugget 0.44 meq/kg, hand pick meat cutlet 0.71 meq/kg and in mechanical de-boned meat cutlet value was 0.76meq/kg. TBARS in fish meat causes some of the sensory specific changes such as smell (Shah, 1999). Disintegration of peroxide leads to production of aldehydes, ketones and TBA (Moieni *et al.*, 2009). Seyfzadeh *et al.* (2013) reported pH 5.57, TBA and peroxide value in control (0.15 mg/kg and 3.75 meq/ kg oil) and in whey protein coated edible film (0.004 mg/kg and 0.06 meq/kg oil) of *Clupeonella engrauli.*

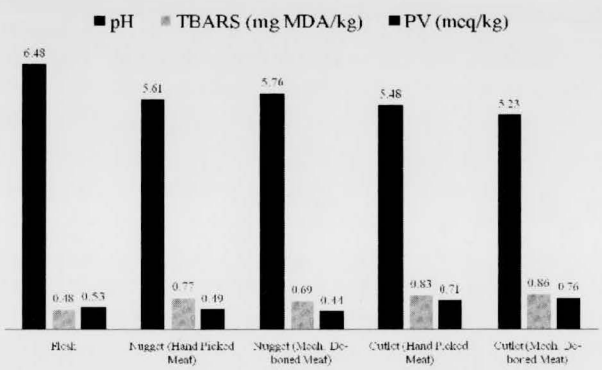

Fig. 1. Chemical Parameter in Fish Flesh and Products

Sensory evaluation of fish products is given in Table 5. All products prepared from meat processed by hand and mechanical de-boning were analysed for appearance, crispiness, juiciness, texture, flavour and overall acceptability. No significant difference was recorded in appearance and crispiness among products prepared from minced meat recovered by the both methods. Juiciness was recorded more in products prepared from mechanical de-boned meat

Table 5. Sensory evaluation of different products

Product Parameters	Fish Nugget		Fish cutlet	
	Hand Pick Meat	Mech. De-boned meat	Hand Pick Meat	Mech. De-boned meat
Appearance	7.77±0.146 [b]	7.33±0.166 [a]	8.00±0.166 [b]	8.11±0.111 [b]
Crispiness	7.55±0.242 [a]	7.55±0.175 [a]	7.66±0.235 [a]	7.55±0.175 [a]
Juiciness	7.11±0.200 [a]	7.33±0.289 [ab]	7.56±0.176 [ab]	8.00±0.236 [b]
Texture	7.44±0.176 [ab]	7.00±0.167 [a]	7.56±0.242 [ab]	7.67±0.236 [b]
Flavour	7.33±0.289 [a]	7.56±0.294 [ab]	8.33±0.236 [b]	8.11±0.200 [ab]
Overall acceptability	7.56±0.176 [a]	7.33±0.236 [a]	7.89±0.111 [a]	7.78±0.278 [a]

* Each value is represented as the mean ±SE

** Means followed by the same superscript within a row are not significantly different (P<0.05)

as compared to hand pick meat. Maximum juiciness was recorded in mechanical de-boned meat cutlet. According to Zayas (1997) juiciness is related to moisture running out of the meat as teeth apply pressure on product. Coating of products helps in moisture loss and maintains the juiciness of product. On acceptability scale, fish cutlets prepared from hand picked meat was recorded. Vanitha *et al.* (2013) also recorded good to excellent scores for fresh fish cutlets prepared from meat of *Catla catla*. Scores for sensory parameters like appearance, colour, odour and overall acceptability for cutlets prepared from *Pangasianodon hypopthalmus* fish remain within the acceptable range for 16 days, when stored in refrigerated display unit at -15 to -18°C (Rathod and Pagarkar, 2013). According to Tokur *et al.* (2006), fish fingers prepared from washed mirror carp (*Cyprinus carpio*) mince meat showed higher preference over unwashed meat product. In the present study overall acceptability of the product was within the range of 'Liked Moderately' and 'Liked Very Much'. Cutlet prepared from hand pick meat was most acceptable on sensory evaluation parameter.

Conclusion

Meat recovery by hand picking method is slightly higher than mechanical deboning but at the same time hand picking method is a slow process and not fit for commercial production. Proximate composition reveals that the product contains good nutritional value. Type of processing method for meat recovery did not affect the overall acceptability of products. It mainly depends on product preparation methodology and consumer's preference. The present study indicates that common carp may be one of the candidate species for the preparation of value added products.

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