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RESEARCH ARTICLE

Textural quality and sensorial acceptability of cutlets from minced meat of three fresh water carp fish species

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Abstract

Textural quality and sensorial acceptability of the cutlets prepared from minced meat of three freshwater carp fishes (*Catla catla*, *Labeo rohita* and *Cyprinus carpio*) were studied. The proximate composition of the cutlets from all three species did not differ significantly. Though, sensorial acceptability and textural attributes of the cutlets were found to vary significantly with species, the differences found were minimal. In terms of textural attributes, cutlets prepared from *catla* were harder than cutlets prepared from rohu and common carp. Cutlets prepared from the meat of all the three fishes were sensorially acceptable. Cutlets made from catla had more acceptability compared to the cutlets made from rohu and common carp. A clear correlation was found between the textural attributes and sensorial acceptability.

INTRODUCTION

At present world fish production is around 145.1 mt with contribution of 45.1 mt from fresh water sources, mainly from culture practices (FAO, 2010). The fish production in India is different from the world scenario, wherein, 4.61 mt have been obtained from inland sources (mainly aquaculture) and 2.99 mt from marine sources during the year 2008–09 (Pandian 2010). Carps contribute maximum to the total inland aquaculture production in India. Despite of their high production, they are less consumed in Punjab state due to presence of intramuscular spines and pin bones. As carps are the major fresh water candidate species for aquaculture in non-coastal states, there is a need to develop bone/spineless value added products from these species for higher consumer acceptability and profitability. Ready to eat mince based fish products are gaining popularity due to convenience, ease in consumption and availability in concentrated forms.

Composition and textural attributes play a vital role in popularizing a food product. Texture and flavour appear to be the most important attributes for the consumer (Stow, 1995). Texture Profile Analysis (TPA) is a technique commonly used in industry for the evaluation of food textural behavior, as it can give an indication of sensory properties (Burey *etal.*, 2009). The TPA includes application of controlled force to the product and recording its response with time. Instrumental TPA has been widely used to evaluate the texture of various protein gels and food products.

TPA is useful for gel texture analysis because of the textural parameters obtained from the TPA curves have been well correlated with sensory evaluation of textural parameters (Sandarson and gum, 1990 and Lau *et al.*, 2000). The popularity of TPA for different foods is attributed to near simulated condition of oral mastication. The application of force to food during oral mastication is well obtained in TPA by force-time curves. The different parameters obtained during TPA include hardness, cohesiveness, springiness, resilience, gumminess, fracturability, chewiness and adhesiveness. Food texture is a collective term that covers several related physical properties, and this means that instrumental analysis cannot fully simulate the overall experience of texture. Instrumental analysis instead measures specific textural properties. Therefore, it is crucial to extract and identify objective measurements that show high correlations with sensory attributes that are interesting to the processing industry and to consumers (MØrkØre and Einen, 2003).

With this rationale the objectives of the study were to prepare cutlets using mince from three different fresh water carp fishes and to study their nutritional, textural quality and sensorial acceptability.

METHODOLOGY

Three freshwater carp fish species namely catla (*Catla catla*), *rohu* (*Labeo rohita*) and common carp (*Cyprinus carpio*) with an average weight and length of 1.25±0.1 kg, 0.8±0.1 kg, 1.5±0.1 kg and 30±5 cm, 20±5 cm and 30±5 cm respectively, were procured from the farm, College of Fisheries, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. The collected fish was brought to the fish processing laboratory under iced condition. The fishes were washed with chilled water followed by beheading, gutting and de-skinning (Figure 1). The de-skinned fish was washed thoroughly with chilled water and deboned using fish meat deboner (Central Institute of Fishery technology, Cochin, India) and minced using meat mincer (Kenwood, India). The minced meat was blended with the ingredients in pre-cooled blender in order to maintain the low temperature conditions. The recipe for cutlet preparations is given in table 1.

After blending the mixture was used to make uniform size fish cutlets using moulds, which were deep fried in refined vegetable oil using deep fat fryer for 60 sec (Figure 1). These fried cutlets were cooled down in desiccator and used for analyzing nutritional value, textural and sensory acceptability.

Proximate analysis of cutlets

The moisture, ash and fat content of the fish as well as cutlets were determined by the method of AOAC, 2000. The crude protein content was determined by estimating the total nitrogen content by the method of AOAC, 2000. The protein content of sample was obtained by multiplying the nitrogen value by a factor of 6.25.

Instrumental texture profile analysis (two-cycle compression test)

The size of the cutlet used for TPA was 3.0 cm x 4.0 cm (diameter x height). TPA was carried out using a Taxt-plus Texture Analyzer (Stable Micro Systems Ltd., Surrey, UK), attached with a 50 kg load cell (Figure 1). A 75 mm diameter compression platen was used with a pre test speed of 1mm/ sec; test speed of 1mm/sec and post-test speed of 5 mm/sec. The cutlets were compressed twice to 40% of the original height at room temperature (30^{o}C) in auto force mode (20 g) and the time gap between first and second compression was 5 sec. Eight measurements were made for each sample in the same lot and average value was reported for each parameter. A force-time graph was generated with data acquisition rate of 200 pps and textural parameters like hardness, cohesiveness, adhesiveness, springiness, brittleness or fracturability, resilience, gumminess and chewiness was calculated with the help of software provided along with the instrument.

Sensory analysis

The cutlets prepared from the mince of three different fresh water fish species were served at room temperature to each judge for sensory analysis. Sensory analyses were done based on a 9-point hedonic scale (from 9 - extremely like, 5 - neither like nor dislike, to 1 - extremely dislike) by six experienced panelists as per the method given by Peryam and Pilgrim, 1957.

Statistical analysis

Statistical analysis of data was performed with the statistical package (SPSS 16.0 for windows, SPSS Inc., Richmond, CA, USA). The assumption of homogeneity of variances was tested for all data, which were log transformed if necessary. The data obtained was analyzed by one way analysis of variance. The textural attributes and sensorial acceptability scores for cutlets from three different fishes were used for one way analysis of variance. In order to assess the test of significance at 5% level between quality parameters of cutlets Duncan's Multiple Range test was used.

RESULTS AND DISCUSSION

TABLES

Table 1. Recipe for cutlets preparation

S.No.	Ingredients	Quantity (%)	S.No.	Ingredients	Quantity (%)

	Fish mince	50.0	09.	Chilly powder	1.0
	Potatoes	15.0	10.	Salt	1.0
	Bread crumbs	10.0	11.	Ginger	0.3
	Egg white	9.0	12.	Pepper	0.2
	Onion	5.5	13.	Coriander leaves	0.2
	Corn starch	4.0	14.	MSG	0.2
	Spice mix	2.0	15	Baking powder	0.1
	Vegetable oil	1.5			

Table 2. Proximate composition of fish mince and the cutlets made from their mince

Component	Moisture	Protein	Lipids	Ash
Fish meat				
C. Catla	78.98 ± 0.32^{a}	17.02 ± 0.06^{b}	1.52 ± 0.02^{c}	1.3 ± 0.02^{b}
L. rohita	78.66 ± 0.36^{a}	18.38 ± 0.15^{c}	1.44 ± 0.02^{b}	1.24 ± 0.03^{a}
C. carpio	80.49 ± 0.31^{b}	16.25 ± 0.33^{a}	1.25 ± 0.03^{a}	1.45 ± 0.02^{c}
Cultlets				
C. catla	58.19 ± 0.46^{b}	16.49 ± 0.15^{a}	15.54 ± 0.21^{b}	4.37 ± 0.05^{b}
L. rohita	59.43 ± 0.12^{c}	16.94 ± 0.1^{b}	14.73 ± 0.05a	4.30 ± 0.07^{b}
C. carpio	57.32 ± 0.13^{a}	16.04 ± 0.29^{a}	16.70 ± 0.44^{c}	3.4 ± 0.11^{a}

Data with different letters in the same row indicates significant differences (P< 0.05) between treatments.

Table 3. Textural attributes of the cutlets

Attributes	C. catla	L. Rohita	C. mrigala
Force	6383.26 ± 44.58^{c}	5761.72 ± 48.56^{b}	4832.66 ± 60.50^{a}
Area-FT 1:2	6963.10 ± 103.96^{c}	4470.25 ± 96.01^{a}	4747.05 ± 78.58^{b}
Time diff 1:2	2.38 ± 0.01^{c}	1.98 ± 0.01^{a}	2.20 ± 0.01^{b}
Hardness	7322.23 ± 58.06^{c}	6443.15 ± 62.51^{b}	5416.75 ± 67.01^{a}
Fracturability	---	---	---
Adhesiveness	-15.70 ± 1.30^{a}	-1.08 ± 0.17^{b}	-0.51 ± 0.09^{c}
Springiness	0.88 ± 0.01^{b}	0.83 ± 0.00^{a}	0.85 ± 0.00^{b}
Cohesiveness	0.57 ± 0.01^{a}	0.59 ± 0.01^{a}	0.63 ± 0.00^{b}
Gumminess	4188.22 ± 64.86^{c}	3784.05 ± 55.58^{b}	3401.19 ± 34.59^{a}

Chewiness	3651.80 ± 54.74[c]	3153.68 ± 51.05[b]	2876.82 ± 29.26[a]
Resilience	0.24 ± 0.01[a]	0.26 ± 0.01[ab]	0.28 ± 0.01[b]

Data with different letters in the same row indicates significant differences ($P< 0.05$) between treatments.

Table 4. Sensory attributes of the cutlets

Sensory attribute	**C. catla**	**L. rohita**	**C. mrigala**
Color	8.33 ± 0.08[c]	7.83 ± 0.12[b]	7.50 ± 0.09[a]
Texture	8.16 ± 0.06[b]	8.00 ± 0.14[ab]	7.83 ± 0.16[a]
Flavor	8.00 ± 0.10[ab]	7.83 ± 0.12[a]	8.33 ± 0.13[b]
Juiciness	8.00± 0.14[b]	7.66 ± 0.08[a]	7.66 ± 0.08[a]
Odor	8.50 ± 0.13[b]	7.66 ± 0.13[a]	7.66 ± 0.17[a]
Appearance	8.50 ± 0.09[b]	8.16 ± 0.06[a]	8.00 ± 0.10[a]
Stickiness	8.16 ± 0.06[b]	7.83 ± 0.12[a]	8.50 ± 0.09[c]
Meatiness	8.00 ± 0.14[a]	8.00 ± 0.14[a]	8.16 ± 0.06[a]
Spiciness	7.83 ± 0.19[b]	7.16 ± 0.19[a]	8.00 ± 0.10[b]
Breadiness	8.00 ± 0.14[b]	7.66 ± 0.17[a]	8.00 ± 0.10[b]
Saltiness	8.00 ± 0.14[b]	7.66 ± 0.13[a]	7.83 ± 0.19[ab]
Overall acceptability	8.16 ± 0.11[b]	8.08 ± 0.11[ab]	8.00 ± 0.00[a]

Data with different letters in the same row indicates significant differences ($P< 0.05$) between treatments.

Figure 1. Set up for texture profile analysis of cutlets from three freshwater fish species

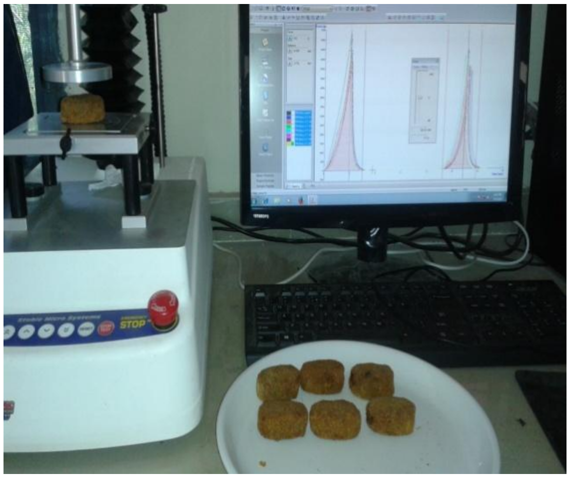


Figure 2. Texture profile analysis of cutlets from *C. catla*

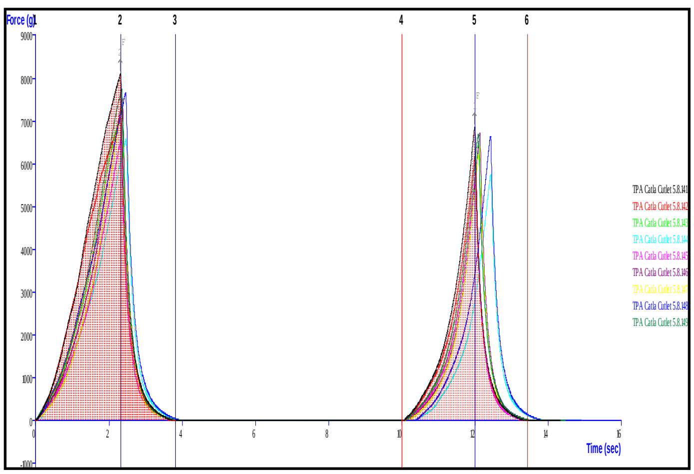


Figure 3. Texture profile analysis of cutlets from *L. rohita*

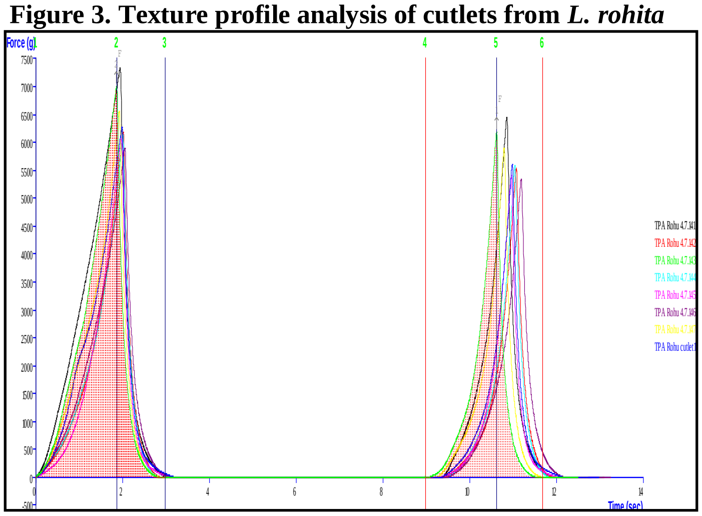
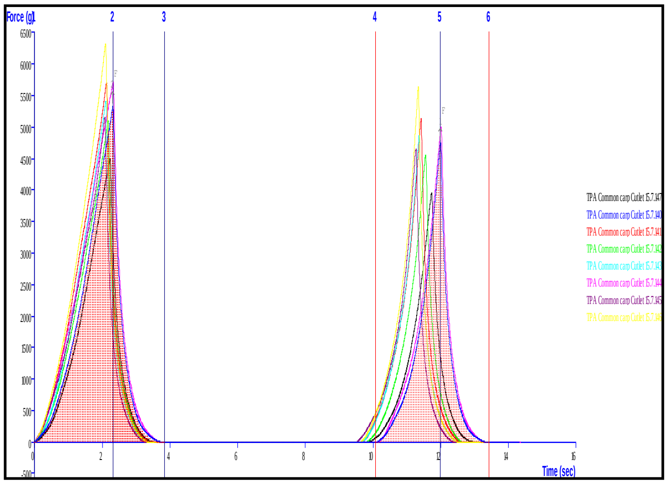


Figure 4. Texture profile analysis of cutlets from *C. carpio*



Proximate composition

The proximate composition of mince from catla, rohu and common carp and cutlets prepared from them is presented in table 2. Proximate composition of all the species varied significantly with respect to protein, lipid and ash content. There was no significant difference found in moisture content of catla and rohu, where as it differed significantly with mince of common carp. The proximate composition of the cutlets made using mince from different fishes differed significantly ($P< 0.05$) with respect to moisture and fat content. There was no significant difference found in protein content between the cutlets from catla and common carp. The ash content also did not show any significant difference between cutlets from catla and rohu.

Texture profile analysis

The values for textural characteristics of cutlets prepared from mince of different fish species are given in table 3 and the related graphs are given in figure 1, 2 and 3. The hardness is related to the strength of gel structure under compression and is the peak force during first compression cycle (Chandra and Shamasundar, 2014). Cutlets prepared from all the species were hard in texture, but no fracturability was observed in any of them. Hardness of the cutlets varied significantly ($P< 0.05$) among species, which was highest in catla followed by rohu and common carp.

Adhesiveness is defined as the negative force area for the first bite and represents the work required to overcome the attractive forces between the surface of a food and the surface of other materials with which the food comes into contact (Kasapis, 2009). Adhesiveness of cutlets varied significantly ($P< 0.05$) with species, which was more for cutlets from catla followed by rohu and common carp.

The cohesiveness (consistency) indicates the strength of internal bonds making up the body of food and the degree to which a food can be deformed before it ruptures (breaks) (Radocaj *et al.*, 2011). Cohesiveness is defined as the ratio of the positive force area during the second compression to that of the first compression. It may be measured as the rate at which the material is disintegrated under mechanical action. Tensile strength is manifestation of cohesiveness. The cohesiveness indicates the ability of the product to hold together (Chandra and Shamasundar, 2014). Cohesiveness of cutlets in the present study also varied significantly ($P< 0.05$) with species and was found to be highest in cutlets from common carp compared to other cutlets from other two species.

Springiness is a textural parameter which is related to elasticity of the sample. Springiness in TPA is related to the height that the food recovers during the time that elapses during end of first bite and the start of the second bite. If springiness is high, it requires more mastication energy in the mouth (Rahman and Al-Mahrouqi, 2009). The springiness of cutlets varied significantly ($P< 0.05$) with species and was found to be maximum for cutlets from catla followed by common carp and rohu.

Gumminess is defined as the product of hardness and cohesiveness. The higher gumminess arises from higher hardness value (Rahman and Al-Mahrouqi, 2009). Gumminess values of cutlets varied significantly ($P< 0.05$). The maximum values were registered for cutlets from catla followed by rohu and common carp.

Chewiness is measure energy required to masticate the food and is normally reported for solid foods. Chewiness is defined as the product of gumminess and springiness which is equal to product of hardness x cohesiveness x springiness (Chandra and Shamasundar, 2014). Chewiness is most difficult to measure precisely, because mastication involves compressing, shearing, piercing, grinding, tearing and cutting along with adequate lubrication by saliva at body temperatures (Bhale, 2004). The chewiness of cutlets varied significantly ($P < 0.05$) with species and it was found maximum for cutlets from catla followed by rohu and common carp.

Resilience is a measurement of how the sample recovers from deformation both in terms of speed and force (Brenda *et al.*, 2005). In simple terms it is the elastic recovery of the sample (Liu *et al.*, 2009). Resilience varied significantly ($P < 0.05$) between the cutlets from catla and common carp. But the resilience of cutlets from rohu was not varied significantly from cutlets of catla and common carp.

From the studies it was revealed that the cutlets prepared from catla had highest values for the textural attributes like springiness, gumminess and chewiness and lowest values observed for adhesiveness, cohesiveness and resilience. All the textural attributes differed significantly ($P < 0.05$) among the species.

Sensorial acceptability

Scores for the sensory attributes of cutlets made from different species are given in table 4. Sensorial scores showed that cutlets made from mince of all three species were sensorially acceptable. The scores for the sensorial attributes for the cutlets varied significantly ($P < 0.05$) with species. Though the differences were very less, overall acceptability of cutlets was found to be highest for cutlets from catla, which was significantly higher than cutlets from common carp but comparable with cutlets from rohu.

A clear correlation was found between the textural attributes and sensorial acceptability. The textural attributes like texture, springiness and chewiness showed that the cutlets made from the mince of catla were superior to the other two. The same was observed with the sensorial acceptability. The cutlets made from the mince of catla got more over all acceptability scores and thus sensorially more acceptable. The less cohesiveness, adhesiveness and resilience values for cutlets from catla are attributed to the toughness of the cutlets.

From this work it is concluded that all the three carp species can be used for the preparation of sensorial acceptable cutlets with good texture. Further TPA can be used as an alternative method to sensorial method for the texture quality analysis of value added products (cutlets) from fresh water carps.

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