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Development and Sensory Evaluation of Silver Carp (*Hypophthalmichthys molitrix*) Fish Based Snack Food

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Abstract: The silver carp *(Hypophthalmichthys molitrix)* is a member of the Cyprinidae family, Silver carp-have long been considered as an important species in Iran because they are easily available at low costs. In an assay to add value, the compounds were supplemented to produce fish chips. Fish chips can be equivalent fish crackers. 10 formulas were developed to produce fish chips from silver carp. Fish-based snacks were formulated with several compounds including mince (with different percentages), different types of flour (wheat, corn, peanuts, peas), wheat starch, fresh garlic, onions, spices (black pepper, paprika, curry, etc.), potatoes, salt and sugar. Then approximate analysis and sensory evaluations were conducted. As it was expected, the protein contents of the fried fish chips were lower than that of the dried fish chips. 10 formulas were evaluated by the panel group (10 people) based on a 7 point hedonic scale. Among the10 formulas, one formula gained the highest score in flavor, odor, color and texture preferences with the overall acceptability levels of 6.2, 7, 6.6, 7and 7 (7–point hedonic scale) respectively, which were significantly different at $p < (0.05)$.

Key words: Fish chips · Mince · Formulation · Potato

INTRODUCTION

Protein shortage has remained as an unresolved problem in developing countries [1]. Fish is a good source of protein and can be used as an alternative to meat (lamb, pork and chicken). The reasons are fish low cholesterol, optimal protein amount, high digestibility and polyunsaturated fatty acids such as omega-3 [2] and essential amino acids [3]. Consequently, fish processing has a special place in fishing and aquaculture industries.

In recent years, the increasing number of working women has directed the consumers' preferences to ready-to-eat fish products like fish burgers, fish cakes, fish crackers, fish fingers, marinated products, etc [4]. Considering the low per capita consumption of fish in developing countries, producing varieties of products can lead to an increasing consumption rate. Silver carp is basically inhabitant of major river systems of South and Central China and in the Amur

Basin of USSR from where it has been transplanted throughout the Indo-Pacific region including India [5]. In recent decades, silver carp has been widely used in European waters for algal control and as a food resource. The Scientific name of silver carp is *Hypophthalmichthys molitrix* that is a freshwater species with high production. Since the silver carp fish has white meat and sweet flavor, it seems appropriate for the production of minced meat products.

One way to add value to the meat is to supplement it with low-protein staples [6], such as potato in fish chips. Since potato in the form of chips has been known to have excellent expansion properties, it is essentially appropriate for meat supplementing. Fish chips is the product of Mince that prepares food in many Asian Southeast countries [7], Particularly in Malaysia, Thailand, Sri Lanka and Indonesia. In these countries the products are named 'cracker' or 'Keropk' [8] and in western countries, they are called 'Expanded snack products'. According to the text, produced chips is one of the most favorable snacks for people, especially children. In addition, to increase the per capita consumption of fish, the produced fish chips -with its low nutritional value- is a suitable alternative to other snacks.

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MATERIALS AND METODS

Preparation of Fish Chips: Silver carp were bought freshly from Gorgan protein Marketplace (their average weight was 900 g and average length was 40 cm). Fish were kept on ice to maintain their quality and nutritional properties and immediately were moved to processed fishery products Laboratory Centre in Gorgan University of Natural Resources. After beheading, intestine cleaning and viscera removing, the meat brown sections were separated from the bones by a mechanical deboner. The fish mince, potato and fish chips were prepared as it is shown in Figure 1. Mince fish were mixed with salt by an electric stirring device for 2 minutes. The quality of dough was determined by the recipe, the quality of used ingredients and the degree to which those ingredients were mixing to obtain a smooth dough. The ingredients of the different formulas are shown in Table 1. a sausage-like mold made of polyethylene (4-6 cm diameter length and 30-35 cm depth) was filled with the produced dough. The sausages were placed into a steam bath (90-95°C) and were steaming for 60 minutes. The steamed doughs were freshened in iced water and chilled for 2 hours in a refrigerator at 5°C. The chilled doughs were cut into 2 to 3 mm thick slices and dried in an oven at 105°C for 1.30 to 2 hours until their moisture content reached to 5% ± 2%. The dried slices were deep fried in vegetable oil at 180°C for 30 seconds. Frying process made the slices expanded and increased their sizes. Finally, a crispy low-density product known as fish chips was obtained.

Table 1: Ingredients in 10 formulae (%)

Treatment Material	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8	F_9	F_{10}
Mince	20	20	20	20	30	30	30	30	30	38.5
Wheat flour	-	-	-	-	-	-	30	30	30	38.5
Wheat starch	-	-	-	-	-	-	-	-	-	-
Pea flour	-	-	-	-	20	7.5	-	-	-	-
Peanut flour	6.7	-	-	-	-	30	-	-	-	-
Corn flour	-	-	-	-	10	-	-	-	-	-
Potato	-	-	78.4	78.3	5.3	-	8.35	8.3	-	-
Mashed potatoes	40	74.3	-	-	-	-	-	-	-	-
Salt	1.6	1.7	1.6	1	1.6	1.6	1.5	1.5	3	2
Sugar	1	1	-	0.3	1	1	1	1	1.5	1
Seasoning	1.1	1	-	-	0.6	0.4	0.35	0.3	-	-
Crushed ice	10	-	-	-	10	10	15	15	15	20
Egg whit	10	-	-	-	10	10	8.5	10	20.5	-
Fresh garlic	0.5	-	-	-	0.5	0.5	1	-	-	-
Fresh onion	4			-	5	4	4	4	-	-
Half-fat yogurt	5	2	-	-	5	5	-	-	-	-

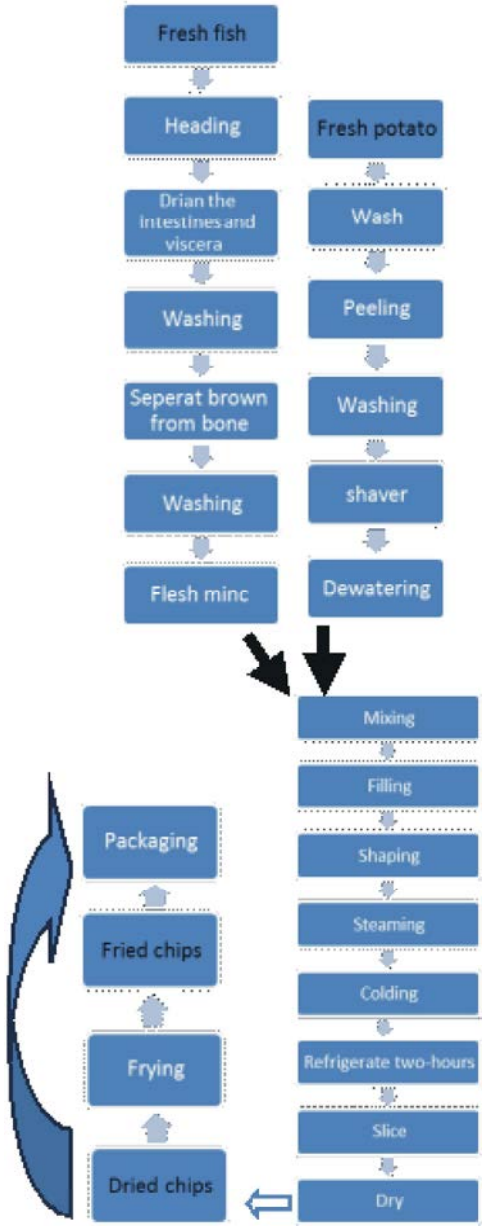

Fig. 1: Fish chips preparation stages flow diagram

Sensory Evaluation and Approximate Composition of Selected Formulations: The sensory evaluation of the produced fish chips was conducted by 10 trained sensory test panels regarding the color, flavor, taste and texture (assessed as brittleness) and the overall acceptability of the snacks was evaluated through different deep-fat frying methods. The scores were assessed on a 7-point scale. The panel members received coded samples of fish chips that were prepared based on ten different formulations. Then they were asked to grade them regarding their strength of color, texture, flavor and

Table 2: Mean values of sensory attributes of fish chips prepared from silver carp (means of ten replications)

Formula	Odor	Texture	Color	Flavor	Overall acceptability
F_1	3.6±1.34^{c}	1.4±0.84^{e}	1.2±0.63^{c}	3.6±1.34^{b}	2.2±1.03^{ed}
F_2	4.2±1.39^{cb}	4.6±1.26^{b}	5.8±1.03^{a}	5.2±1.13^{a}	5±0.94^{b}
F_3	4.2±1.39^{cb}	4.8±1.13^{b}	5.8±1.03^{a}	5.4±0.84^{a}	4.6±0.84^{cb}
F_4	7±0^{a}	7±0^{a}	6.6±0.84^{a}	6.4±1.3^{a}	7±0^{a}
F_5	4.8±1.75^{b}	3.4±1.57^{c}	2.8±1.13^{b}	3.6±1.34^{b}	4±1.05^{c}
F_6	3.2±1.75^{c}	3.2±1.47^{c}	2.4±1.64^{b}	2.6±1.26^{cb}	3±0.94^{d}
F_7	2±1.05^{d}	3.2±1.47^{c}	2.6±1.57^{b}	3±1.33^{b}	2.2±1.03^{ed}
F_8	1.8±1.03^{d}	3±1.33^{dc}	3.4±1.26^{b}	1.8±1.03^{dc}	1.8±1.03^{ef}
F_9	1.2±0.63^{d}	2±1.05^{ec}	2.8±1.75^{b}	1.2±0.63^{d}	1±0^{f}
F_{10}	1±0^{d}	2.4±0.96^{ec}	3.6±0.96^{b}	1±0^{d}	1.4±0.83

*(a-f) Different superscript letters at the same column indicate significant differences in the formulation.

*Data are presented as mean ± standard deviation (SD).

Table 3: Percentage of chemical composition of selected formulations (means of three replications)

Treatment	Protein	Ash	Total fat	Moisture	Carbohydrates
Raw dough	4.14± 0.25	8.03± 0.62	4.32± 0.76	76.83± 0.11	6.68±.24
Baked Dough	4.11± 0.43	8.93± 1.1	1.45±0.03	76±0.20	9.5±1.32
FCD[1]	16.06± 0.83	5.88± 0.11	21.24± 2.35	3.48± 0.42	67.54±.84
FCF[2]	9.52± 0.44	9.34± 0.2	1.21± 0.21	5.84± 0.14	48.62±.79

1) Dried Fish chips 2) Fried Fish chips

overall acceptability. Sensory evaluation was conducted concerning the color, flavor, taste, texture, overall acceptability and the production method (drying or deep frying) F_4 had the highest acceptability levels for color, texture and flavor compared to other formulas. It also showed an excellent brittleness or crispness that is the most important sensory characteristic of the fish chips [9]. Brittleness appears to occur as a result of brawn evaporation of water inside the dropsical granules when the initial product is exposed to high temperatures [10]. The taste panelists found a significant difference in the texture, odor and overall acceptability of the selected formulation (Purpose is F_4). The sensory evaluations of the other formulations are shown in Tables 2.

Moisture content was determined according to the AOAC methods, crude protein according to Kjeldahl method (Nx6, 25) Association of official analytical chemists [11]. Crude fat was done according to Parvaneh [12] while crude ash was done according to Parvaneh [12]. The proximate analyses of the selected formulations are shown in Tables 3. As it was expected, the protein content of the fried fish chips was lower than that of the dried fish chips because of the oil absorption during the frying process, which was consistent with the obtained results by Abimbola [9].

Statistical Analysis: Statistical analysis of data was performed using SPSS software. Levene's test was used to assess homogeneity of variances and the normality of the data was checked through Kolmogorov – Smirnov test. Duncan ANOVA test was used at the 5% level of significance for analysis of the presence or absence of significant differences between the proposed formulas. Correlation test was also used to find the relationship between the two main studied attributes.

CONCLUSION

Chips were produced from silver carp with various formulas. Acceptable fish chips were made of silver carp and potato in formula 4. Laboratory sensory scores and preliminary large-scale sensory evaluation trials were favorable and encouraging. Processing these aquatic species to produce value-added products by using simple technology not only increases their economic values but also encourages the utilization of these underutilized resources. This process can also contribute to poverty alleviation and income generation in the developing countries. Production of fish chips, apart from increasing people's protein intake, also will result in increased health and reduced risk of cancer. In addition it has the potential to support a small regional factory in a developing economy.

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