

STUDY ON NUTRITIONAL QUALITY OF SOME SMOKED PRODUCTS FROM SILVER CARP (*HYPOPHTHALMICHTHYS MOLITRIX*) AND BIGHEAD CARP (*HYPOPHTHALMICHTHYS NOBILIS*)

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Abstract

*The study aimed an analysis of the nutritional characteristics of smoked products from silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Hypophthalmichthys nobilis*). Sixteen products were analyzed, eight samples of smoked silver carp (A products) and eight of bighead carp (B products).*

The proteins, lipids, collagen and water content was determined using the automated analyzer Food Check (infrared spectrophotometer); mineral substances were determined by calcination at 550 °C and the carbohydrates content and energy value were determined by calculation, using conventional formulas.

The most important differences between the products analysed, have targeted the content of lipids, with difference of 2.48 percentage points (4.13% for B products and 1.65% for A products). The salt content was higher for B products (4.54%), compared with A products (3.40%), with differences of 1.14 percentage points.

The obtained data were statistically processed by classical methods and through the test for analysis of variance ANOVA. Mostly significant ($p < 0.05$), distinct significant ($p < 0.01$) and very significant differences ($p < 0.001$) were observed between the smoked fish products analysed at the level of chemical composition and energy value, with exception of proteins, ash and carbohydrates content where not significant differences were observed ($p > 0.05$).

Key words: smoked products, proteins, lipids, ash, salt.

INTRODUCTION

Carp is one of the most widely cultured and traded species all over the world due to its fast growth rate, easy cultivation, high feed efficiency ratio and high nutritional value (Shi et al., 2014, Lazar et al., 2012, Kachele et al., 2017). The species' of fish markedly affects the proximate composition and amino acid profile of their muscle tissue (Pyz-Lukasik and Paszkiewicz, 2018). Depending on the species, fish muscle tissue contains 12.2–21.79% proteins (Ozyurt and Polat, 2006; Tzikas, et al., 2007; Hadjinikolova et al, 2008; Usydus et al, 2011; Ghomi, 2012; Ljubojevic et al., 2013), 0.08–13.1% lipids and 67.3–86.7% water (Ozyurt and Polat, 2006; Usydus et al, 2011; Naseri et al 2010; Karl et al, 2014).

The energy value of the muscle tissue of different fish species, which depends on the proportion of its basic components, ranged from 210.7 to 797.5 kJ/100 g (Usydus et al, 2011; Skalecki et al, 2013).

Silver carp is one of the most commonly raised freshwater fish species throughout the world due to its wide availability, low cost of aquacultural production, high feed efficiency ratio and nutritional values (Valipour et al, 2017). It is well known to be rich in proteins, polyunsaturated fatty acids, lipidsoluble vitamins and micronutrients (Siddaiah, et al, 2001, Rezaei and Shahbazi, 2018).

Bighead carp culture was first initiated in the areas along Yangtze River and Pearl River in the southern part of China, much later than the culture of common carp. It can also be found in some wild environments of Europe, South America and North America (Shi et al., 2013).

MATERIAL AND METHOD

Sixteen products were analyzed, eight samples of smoked Silver carp (A manufacturer/ products) and eight of bighead carp (B manufacturer/ products). The samples were chopped and homogenized with an electric shredder.

The water, proteins, collagen and lipids content were determined using the Food Check Near Infrared Spectrophotometer (NIRS technology); the energy value was determined by calculation using conventional formulas and crude ash content was assessed after AOAC, 1990, by calcinations (at 550°C for 18 h after a preliminary carbonization).

The energy conversion factors were: 4.27 for proteins, 9.02 for lipids and 3.87 for carbohydrates (according to Atwater system/ FAO relations, 2003). The achieved results were statistically processed through the main descriptors computation: arithmetic mean, \bar{x} , standard deviation, s , coefficient of variation, $V\%$, and by analysis of variance test (ANOVA)

RESULTS AND DISCUSSION

The chemical composition and energy value of Silver carp *Hypophthalmichthys molitrix* (A) and Bighead carp *Hypophthalmichthys nobilis* (B) are presented in Table 1 and Table 2.

The most important differences between the products analysed, have targeted the content of lipids, with difference of 2.48 percentage points (4.13% for B products and 1.65% for A products).

The average proteins content was higher for A products (21.83%), compared with B products (20.91%), with differences of 0.92 percentage points. The collagen content was higher for A products (4.5%), compared with the B products (3.45%), with differences of 1.05 percentage points,

probably and because the total proteins content was higher for this products (Fig 1.).

The water content was higher for A products (70.47%) compared with B products (69.08%) with differences of 1.39 percentage points. Also, the dry matter and inclusively the organic matter were higher for B products compared with A products.

Table 1.
Chemical composition and energy value of Silver carp *Hypophthalmichthys molitrix* (A)

Chemical components and energy value	$\bar{x} \pm s\bar{x}$	V%	Min.	Max.
Lipids%	1.65± 3.16	9.96	1.40	1.90
Proteins%	21.83± 1.52	2.31	21.10	22.60
Collagen%	4.50± 1.69	2.85	3.32	4.72
Water%	70.47± 0.87	0.75	69.10	73.20
Salt%	3.40± 2.43	5.88	3.10	4.70
Ash%	5.47± 2.36	5.58	5.03	5.70
Dry matter%	29.53± 1.34	1.80	28.80	29.90
Organic matter%	24.07± 1.74	3.02	23.19	24.87
Carbohydrates %	0.58± 5.97	9.37	0.29	1.47
Energy kcal/100g	110.37± 1.66	2.76	101.58	137.44
Energy kJ /100g	461.80±2.34	2.76	445.94	478.83

V%=coefficient of variation.

The salt content was higher for B products (4.54%), compared with A products (3.40%), with differences of 1.14 percentage points. The ash content was very close for the tow products analysed, a little bit higher for products A (5.47%) compared with B products (5.41%). The carbohydrates content was also close for the tow products analysed, a little bit higher for A products (0.58%) compared with B products (0.48%).

Table 2.
Chemical composition and energy value of Bighead carp *Hypophthalmichthys nobilis* (B)

Chemical components and energy value	$\bar{x} \pm s\bar{x}$	V%	Min.	Max.
Lipids%	4.13± 4.28	4.76	1.49	6.98
Proteins%	20.91± 1.47	3.22	18.19	21.47
Collagen%	3.45± 1.23	1.15	1.55	3.69
Water%	69.08± 2.12	0.47	66.40	73.20
Salt%	4.54± 1.49	3.66	2.35	5.34
Ash%	5.41± 1.25	7.11	4.13	5.89
Dry matter%	30.62± 2.56	2.31	27.80	33.70
Organic matter%	25.22± 1.32	1.09	22.43	27.69
Carbohydrates %	0.47± 3.56	6.21	0.33	1.07
Energy kcal/100g	128.36± 3.15	4.12	105.79	154.59
Energy kJ /100g	537.05±1.17	1.98	466.91	591.07

V%=coefficient of variation.

The mean carbohydrates content was higher for products B (128.36 kcal/100 g) this having more lipids in composition compared with A product (110.37 kcal/100 g), differences of 17.99 kcal/100 g (Fig. 2).

Mostly significant ($p < 0.05$), distinct significant ($p < 0.01$) and very significant differences ($p < 0.001$) were observed between the smoked fish products analysed (Table 3), at the level of chemical composition and energy value, with exception of protein, ash and carbohydrates content where not significant differences were observed ($p > 0.05$).

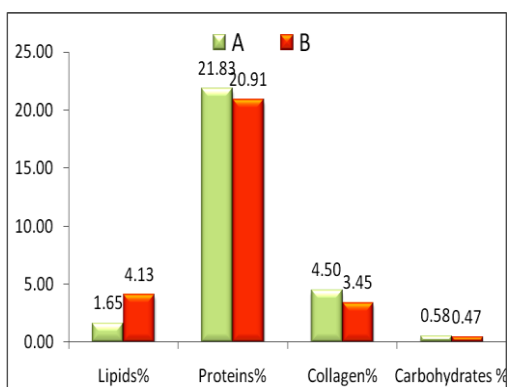


Fig. 1. Chemical composition of A and B products

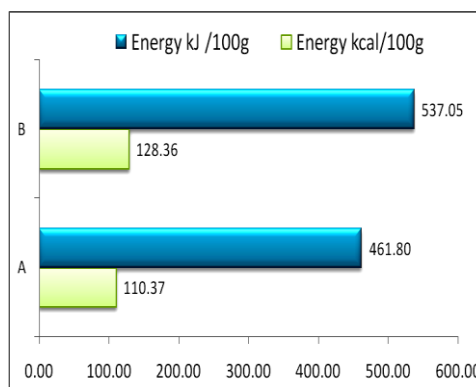


Fig. 2. The energy value of A and B products

Table 3

The statistical significance of the differences for Silver carp *Hypophthalmichthys molitrix* (A) and Bighead carp *Hypophthalmichthys nobilis* (B)

ANOVA		A-B
Lipids	S	***
	P value	5.5E-05
Proteins	S	ns
	P value	0.0522
Collagen	S	*
	P value	0.0174
Water	S	**
	P value	0.0085
Ash	S	ns
	P value	0.8887
Salt	S	**
	P value	0.0051
D.M.	S	*
	P value	0.0285
O.S.	S	*
	P value	0.0344
Carbohydrates	S	ns
	P value	0.24224
Energy kcal/100g	S	***
	P value	2.53E-15

n.s.(not significant)= $p > 0.05$; *(significant)= $0.05 > p > 0.01$; **(distinct significant)= $0.01 > p > 0.001$; ***(highly significant)= $0.001 > p$.

Pyz-Lukasik et al, 2018 found mean values of 73.56% water, 15.98% protein, 8.93% lipids, 1.10% ash and 144.27 kcal/100 g energy value in the fresh muscle tissue of bighead carp. Shi et al 2013 found similar value for juvenile bighead carp. In the smoked products, nutrients are more concentrated (and in the present study), because some of the water is removed in the cold/hot smoking process and salt is added in different concentrations. Thus, Shehata et al, 2018, found the following mean values of water, proteins, lipids, carbohydrates, ash and energy value: 78.11%, 16.55%, 2.31%, 1.16%, 1.87%, 91.63±1.49 kcal/100g for raw grass carp; while it was recorded 48.22%, 23.38%, 13.88%, 8.14%, 6.38%, 251.05 kcal/100g for hot smoked grass carp fillets with 10% salt. On the other hand, Vujkovic et al 1999, analysing the composition of fatty acids and total lipids in the fresh muscle tissue of silver carp and bighead carp, showed that there is no significant difference either in the content of polyunsaturated n-3 and n-6 fatty acids, or in the n-6/n-3 fatty acids ratio in these two fish species. The lipids of both the silver carp and bighead carp from the spring harvest have significantly higher contents of the n-3 fatty acids and a significantly lower n-6/n-3 ratio than fish from the autumn harvest.

CONCLUSIONS

The analyzes performed revealed the most important differences between the products A and B at the level of lipids content, with difference of 2.48 percentage points (4.13% for B products and 1.65% for A products). The salt content was higher for B products (4.54%), compared with A products (3.40%), with differences of 1.14 percentage points. Mostly significant ($p < 0.05$), distinct significant ($p < 0.01$) and very significant differences ($p < 0.001$) were observed between the smoked fish products analysed at the level of chemical composition and energy value, with exception of proteins, ash and carbohydrates content where not significant differences were observed ($p > 0.05$).

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