

Inclusion of shavings (Cut "V") Tilapia fillets smoked of the processing beef hamburgers¹

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ABSTRACT. The objective of the research shavings get in "V" removed at the time of tilapia, which were immersed in brine, drained and dried, smoked, pounded, shaped and included levels 0, 5, 10 and 15% in processing beef hamburgers. It is the effect of inclusion on the proximate composition (moisture, protein, fat, calcium, phosphorus and iron) and sensory analysis (flavor, color, texture, appearance, salt content and general acceptance). The data obtained were submitted to the ANOVA, by utilizing the Sisvar program and statistical tests for the linear regression at the level of 10% of probability. It follows that the best centesimal composition centesimal was obtained with the level of 10% when compared with the other treatments. The burgers with shavings smoked had higher levels of calcium and phosphorus compared to shavings without fillet, higher value added observed when 10% smoked shavings. There were significant differences for all sensory parameters evaluated. Being considered the best inclusion level of the shavings in burgers is 10 due to its acceptability. The shavings are considered a good alternative to the use of waste from tilapia filleting.processing.

KEYWORDS: smoking, minerals, *Oreochromis niloticus*, fish, sensorial properties, residues filleting

Inclusão de aparas (corte em V) do filé de tilápia defumadas no processamento de hambúrgueres de carne bovina

RESUMO. Objetivou-se com a pesquisa obter aparas em "V" retiradas no momento da filetagem de tilápia, que foram imersas em solução salmoura, drenadas e desidratadas, defumadas, moídas, moldadas e incluídas nos níveis 0, 5, 10 e 15% no processamento de hambúrgueres de carne bovina. Verificou-se o efeito dessa inclusão sobre a composição centesimal (umidade, proteína, gordura, cálcio, fósforo e ferro) e análise sensorial (aroma, cor, textura, aparência, teor de sal e aceitação geral). Os resultados obtidos foram submetidos à ANOVA, utilizando-se o programa SISVAR e os testes estatísticos para a regressão linear ao nível de 10% de probabilidade. O melhor teor de proteína bruta foi para o nível de inclusão de 10% de aparas defumadas ($p < 0,05$), quando comparada aos demais tratamentos. Os hambúrgueres com aparas defumadas apresentaram maiores teores de cálcio e fósforo comparados aos sem aparas de filé, sendo maior valor observado quando adicionada 10% de aparas defumadas. Houve diferença significativa para todos os parâmetros sensoriais avaliados. Sendo considerados 10% o melhor nível de inclusão de aparas no hambúrguer devido à sua aceitabilidade. As aparas são consideradas uma boa alternativa para o aproveitamento de resíduos de filetagem da tilápia.

Palavras chave: Defumação, minerais, *Oreochromis niloticus*, pescado, propriedades sensoriais, resíduos de filetagem

Introduction

The consumption of fish has reached historic levels according to the United Nations reports for Food and Agriculture (FAO), which accounts for, in 2010, a mean of 17 kilograms per person. According to the FAO (2010), the amount shows that for 3 billion persons; the fish is 15% of the average diet of animal origin protein. That increase is due basically to the continuous increase of the production by aquaculture, which

is foreseen to surpass the catch fishing as a source of fish.

Brazil is the country which presents the greatest potential in the world for fish production through aquaculture, having in mind the vastness of its territory with more than 2/3 occupying the tropical region, privileged and rich drainage basins, where the Amazonian basins stands out, responsible for 20% of the world's freshwater.

Table 1. Base formulation of the hamburgers with the inclusion of smoked tilapia trims

Parameters	Treatments			
	Inclusion of percents of smoked trims			
Raw materials (grams)	0%	5%	10%	15%
Beef meat	1650	1568	1485	1403
Smoked tilapia trims	0	82.5	165	247.5
Bacon	165	165	165	165
Textured soy bean protein	49.5	49.5	49.5	49.5
Salt	33	33	33	33
Pepper	1.6	1.6	1.6	1.6
Total	1899.1	1899.6	1899.1	1899.6

Through the homogenization of all the components, a compact paste was obtained which was divided and weighted into portions of 60 g, shaped and pressed in a hamburger grill 11 cm in diameter. The hamburgers were wrapped in film paper and stored in freezer till the moment of its use for the sensorial and physicochemical analyses (Figure 2).



Figure 2. Hamburgers in film paper and identified by treatment.

In continental aquaculture, pisciculture with farming of tilapias and several species of carps (common, big head, grass, silver plated carp),

the round fish (pacus, tambaquis and their hybrids), mainly in the South, Central-West and Southeast, stand out, where fish-pay projects, several fish farmers and processing industries have established.

The samples of the four treatments were submitted to the sensorial analyses and of centesimal and mineral composition. The analyses of moisture were conducted according to the Association of Official Analytical Chemists' methodology (AOAC, 1997). For the determination of the crude protein content, the semi-micro kjeldhal method was utilized, by multiplying the total nitrogen content by the factor of conversion of value equal to 6.25 and the determinations of ether extract by the Soxhlet method (Silva & Queiroz, 2002).

In the analyses of calcium, phosphorus and iron, compound samples of the hamburgers were utilized. For calcium and iron, the digestion in acidic medium was utilized and the determination performed by flame atomic absorption spectrometry (FAAS) as the procedure reported by Zhou et al. (1998). And for phosphorus, spectrophotometry ammonium phosphomolybdate according to Eijssink et al. (1997) was utilized.

For the sensorial analysis, subsamples of the hamburgers (± 20 g) were evaluated by a panel of 40 untrained tasters, aiming to reach the average consumer. These samples were placed on small plastic dishes, packed in aluminum paper, identified and offered to the tasters.

The tasters were given in a random way the samples codified with numbers also random and a card for sensorial analysis. The attributes of flavor, taste, appearance, texture, color, salt content and general acceptance of the hamburger samples of the four treatments were evaluated. So, a card with a 9-point hedonic scale with the extremes 1 (I disliked very much) and 9 (I liked very much) (Moraes, 1993; Stone; Sidel, 1993; Dutcosky, 1996).

The variables of the centesimal and sensorial composition were submitted to the analysis of variance (ANOVA) and the statistical tests (linear regression and Tukey for comparison of

means) were conducted at the level of 5% of probability by using the Sisvar program (Ferreira, 2000). Statistical analysis for minerals was carried out.

Results and discussion

The centesimal composition of the beef hamburger with levels of inclusion of smoked tilapia trims is in Table 2.

The greatest moisture content and the smallest ether extract content were found in the sample of 0% of inclusion of the trims. It was observed that there was a reduction of moisture with the addition of the smoked trims; this is due to the moisture coming from the process of dehydration of the trims during smoking. It is found that in the hamburgers the greatest inclusion of smoked trims (15%) presented the lowest ether extract content when compared with the other.

Table 2. Centesimal and mineral composition of hamburgers with the addition of smoked tilapia trims.

Variables	Levels of inclusion of smoked tilapia trims				P	CV
	0%	5 %	10%	15%		
Moisture, %	90.20	84.31	84.42	85.57	0.4971	7.02
Crude protein, %	5.28	7.57	7.16	6.74	0.0430	7.58
Ether extract, %	2.66	4.07	4.10	3.78	0.8126	6.87
Calcium, %	0.0769	0.7784	0.7877	0.1778	0.0000	0.00*
Phosphorus, %	0.3944	0.3732	0.7523	0.3164	0.0000	0.00*
Iron, %	0.7400	0.6500	0.3300	0.5700	0.0000	0.00*

Paleari et al. (1998) reported moisture values of the ostrich meat of 75.1% and beef of 74.2%, values which are very inferior to those obtained in this study. It is important to stress that the high moisture foods can deteriorate more easily due to the increased water activity and consequently because of the development of microorganisms. The moisture values found were different from those verified by Marengoni et al. (2009), when utilizing the mechanically deboned tilapia meat fish burger (71.05 to 76.80%). That alteration can be due to the PTS utilized being with lower moisture content at the moment of the inclusion as well as the sort of ETA utilized. Marengoni et al (2009) utilized only fish meat, while in this experiment; beef with the inclusion of smoked trims was used.

Finkler et al. (2010) made fish hamburgers (mandi-pintado *Pimelodus britskii*) and these

present moisture contents of 61.29%, 18.57% of crude protein and 12.76% of lipids. The moisture reported by the authors was inferior to the values obtained in this experiment of the beef hamburger with only the addition of smoked tilapia trims. Beef being able to be much moister at the moment of hamburger-making, associated with the factors already mentioned previously.

There was a significant effect ($p < 0.05$) for the crude protein content, the greatest value being found when of the inclusion of smoked tilapia trims into beef hamburgers with 5%. The regression equation observed for that parameter was: $Y = 539262.7500 - 1.4528X + 0.000007X^2$ ($R^2 = 0.9999$), the inflexion point being obtained at 6.68%.

Pereira et al. (2003) determined values of 13.23% of crude protein in both fish burger and nugget and this value was much higher than that

found in this experiment. One can infer that the beef utilized presents a lower protein content, in spite of the trims presenting higher protein value, its being possible to observe sharply that after the inclusion of the smoked trims, the hamburgers present a higher protein content as compared with those which were not added the trims (Treatment 1). It is also important to remember that the lower the moisture content of a product means that in this one, the other nutrients (protein, lipids and minerals) present higher values.

The values of ether extract and protein found in this experiment were, respectively, similar (4.19%) and inferior (19.44%) to the hamburgers processed with caiman meat made by Romanelli et al. (2002). The same occurred for the calabresa sausage hamburger (7.4% of ether extract and 18.8% of protein) reported by Romanelli et al. (2002). According to Ogawa and Maia (1999), great variation occurs in the content of ether extract in fish meat owing to the ether extract sort of body muscle in a same species; exemplifying the tuna which can present contents of 1 to 2% of ether extract in the dorsal meat and up to 20% of ether extract in the abdominal meat.

Garcia (2003) states that the fish is considered one of the foods most complete to man due to its nutrient value. Though, the crude protein contents are found in this work were inferior to those found in meats of other species cited in the literature, this due to the reduced addition of fish into the hamburgers.

One can consider that the majority of the metal atoms is present in the fish muscle, but sodium, potassium, calcium, magnesium, phosphorus, chlorine, sulfur and iron are the principal ones. Therefore, from among those minerals only calcium, iron and phosphorus were analyzed in the hamburgers with the addition of smoked trims. According to Costa (2006), ashes, calcium, iron, phosphorus, copper and magnesium, present in the fish meat has a proportion identical to that of other kinds of meat, their being around 0.8 to 2%. Ogawa and Maia (1999) found from 1 to 2% of ashes; Marengoni et al. (2009) found values from 1.12 to 2.44% of ashes, values also observed in this experiment.

The contents of calcium, phosphorus and iron ranged greatly in the present experiment, this can be due to the technological process in the making

of the hamburgers and sampling conducted. Maybe with the mincing done on the smoked trims, the particle size obtained associated with the presence of spines present in the trims and even with the greatest homogeneity of the raw material at the moment of including it into the hamburgers, more spines minced in hamburgers have gone from one or other treatment. Also, during the sampling, samples can have been removed in positions where there were more or fewer minced spines, interfering in the results of the minerals in each treatment. The ideal would be to utilize a greater number of sampling, which unfortunately was not possible to do at the moment of the conduction of the experiment.

As to the increase of the calcium content in the smoked trim hamburgers with the addition of trims and these ones present spines, even with the mincing and homogeneity of the mass, when added in the hamburgers, the spines got distributed randomly and with the removal of the samples in the hamburgers, it may be that the spines were in one or another part at greater concentration, interfering in the results of calcium. Nevertheless, independent of the level of addition of smoked trims, there was an increase in the contents of calcium in the hamburgers compared with the ones without smoked tilapia fillet trims.

The hamburgers with addition of 10% of smoked trims presented a higher content of phosphorus and lower of iron in relation to the hamburgers of the other treatments.

The results obtained in the sensorial analysis were significant ($p < 0.05$) for all the variables evaluated, showing that there is difference among the levels of inclusion of smoked tilapia trims in beef hamburgers (Table 3).

Through the hedonic scale used for the evaluation (Stone & Sidel, 1993), it is found that for all the surveyed variables, the hamburger with the inclusion of 10% of smoked tilapia trims obtained the greatest acceptance of the tasters with scores comprehended in the group I liked it fairly", represented by the score 7 and "I liked it very much", represented by the score 8, the values of which were of 7.75 to 8.20.

For all the evaluated characteristics there was a quadratic effect with the regression equations of each variable available in Table 4.

Table 3. Responses in the sensorial variables with different levels of inclusion of smoked tilapia trims into hamburgers.

Variables	Levels of inclusion of smoked tilapia trims				P	CV
	0%	5%	10%	15%		
Flavor	6.37	7.35	7.92	7.35	0.0000	15.71
Taste	6.35	7.75	8.02	7.40	0.0000	14.11
Appearance	7.32	7.52	7.90	7.52	0.0000	10.27
Texture	7.00	7.30	7.80	7.60	0.0000	11.33
Color	7.47	7.15	7.75	7.35	0.0001	10.09
Salt content	6.80	7.42	8.17	7.32	0.0000	13.83
Acceptance	6.65	7.85	8.20	7.57	0.0000	11.99

Pessatti (2001) made a protein concentrate of fish through successive washings with ethanol and reported that the flavor was characterized as of seafood, for the tasters, the inclusion of smoked tilapia trims, improved the flavor of the

hamburgers with means of 6.37 to 7.92. The means for the variables taste ranged between 6.35 and 8.02 and, therefore, they were in the range of "I liked it slightly" and "I liked it very much".

Table 4. Equations of the effect of the levels of inclusion of smoked tilapia trims upon the sensorial variables

Variables	Equations levels of tilapia trims	r ²	Estimated means
Flavor	$\hat{Y} = 6.3375 + 0.3025 X_i - 0.0155 X_i^2$	0.9773	7.25
Taste	$\hat{Y} = 6.361250 + 0.37225 X_i - 0.0020250 X_i^2$	0.9984	7.38
Appearance	$\hat{Y} = 7.278750 + 0.105750 X_i - 0.005750 X_i^2$	0.7527	7.57
Texture	$\hat{Y} = 6.955 + 0.121 X_i - 0.0050 X_i^2$	0.8898	7.42
Color	$\hat{Y} = 7.475000 - 0.285833 X_i + 0.002567 X_i^2$	1.0000	7.43
Salt content	$\hat{Y} = 6.713750 + 0.267750 X_i - 0.014750 X_i^2$	0.8455	7.43
Acceptance	$\hat{Y} = 6.64375 + 0.336250 X_i - 0.018250 X_i^2$	0.9994	7.57

The scores for the parameter of salt contents were greater in the treatments which received the trims as a consequence of the brining process (addition of salt through brine) and the moisture reduction with the smoking process. The acceptance of a product by the tasters is related with different habits and cultural standards, individual sensitivity, age, fidelity to certain brands, hygiene, consumption place, number and sort of companion at the moment of consuming the product, among other aspects (Dasso, 1999).

Conclusions

Under the conditions which the experiment was conducted, it follows that the best results obtained as to the contents of proteins, mineral

and sensorial was for the inclusion of 10% of smoked tilapia trims in beef hamburgers when compared with the other treatments. It was shown that there was increased acceptability of the product by the tasters with the addition of 10% of smoked trims. Those trims presenting a good potential for the smoking and inclusion in hamburger, its being indicated as an alternative to the use of solid fish residues of the fish processing, that is, of the tilapia filleting.

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