Comparative study of the physicochemical characteristics of an economic Buffalo (Bubalus bubalis) meat product and an economic Beef (Bos indicus) meat product with incorporation of bovine hemoglobin in powder in both formulations

J.F. Rey, C.L. Martínez, A. Urrea

Abstract

The low dietary intake of bioavailable iron is the major cause of iron deficiency; nowadays, researches are being made to develop iron supplements. The objective in the diet is to increase iron intake through food fortification and dietary diversification as strategies to prevent deficiency of this mineral (WHO, 2004). Since a few years ago, it has been suggested that hemoglobin in powder is used as a supplementation with iron, also it has shown that, given the structure of it, constitutes an iron shield against absorption inhibitors and foments iron to arrive intact to wall of cells where it is absorbed, apparently the absorption is better when Iron is bound to hemoglobin than the heme-iron without globin (Guerrero, 2006).

Several studies have shown the higher proportion of iron in buffalo meat, in comparison with other species, its high protein content and low fat values becoming a raw material with great potential for industry (Cedres, 2003), for this study, both Buffalo and beef, were characterized physico-chemically, revalidating the information obtained in other researches.

The purpose of the addition of bovine hemoglobin in economic sausages made from Buffalo and one from beef, was measuring the influence of this addition on the physicochemical characteristics and the final Iron content on both products.

The formulation of sausages was following the procedures of meat emulsions (Ranken 2003).

Three sausages were made with meat Buffalo (B), 200 mg / kg of hemoglobin (range selected from Carrasco and Duke research, 2009), and three beef (R) with same level of hemoglobin.

To evaluate the physicochemical characteristics were measured: Total ash (NTC 1668), Humidity (NTC 1663), protein (NTC 1556), fat (NTC 1662) and iron (AOAC 944.02). The statistical analysis was performed with ANOVA (P <0.05), then were compared with Tukey (P <0.05) and the difference between samples with bilateral Dunnet test (ICS 95%).

Statistical treatment showed non significant differences for fat (%) (R=14.2352 and B=9.7446), moisture (%) (R = B = 64.9434 and 65.3612), protein (%) (R=13.5347 and B=14.0219) and pH (B=7.01 and R=6.71) values. Difference was significant in ash (%) (R = 1.7572 and B=2.8013) and iron (B=2.82 mg / kg and R =2.52 mg / kg) values, Iron data exceed the minimum recommendations for Iron in Colombia (1184 mg / kg, ICBF) and food in Latin-America (1.1 mg/kg, FAO).

Buffalo product presents a better physicochemical and healthy characteristics respect to beef product, especially in terms of protein, fat and iron values compared to the FAO and ICBF values. The result was an economic meat product with hemoglobin according to the 1325 NTC.
Keywords: iron; meat buffalo; meat product; bovine hemoglobin; incorporation.

Introduction

Low dietary intake of bioavailable iron is the major cause of iron deficiency and anemia deficiency. The food-based approaches to increase iron intake through fortification food and dietary diversification are also important strategies to prevent low levels of iron (WHO, 2004).

Several studies have demonstrated that buffalo meat has higher iron proportions than other species, protein content and low fat values becoming a raw material of high potential for industry (Cedres, 2003).

The purpose of the addition of bovine hemoglobin in economic sausages from Buffalo and one from beef was to measure the influence of this addition on the physicochemical characteristics of the product, and final content iron.

Materials and methods

The product was made following sausage meat emulsions formulation (Ranken 2003). Were designed and developed three buffalo meat sausages (B) with 200 mg/kg of hemoglobin (range selected from Aleppo research and Duke, 2009), and three beef (R) with the same hemoglobin concentration.

To evaluate the physicochemical characteristics of the sausages, were tested: Total ash (NTC 1668), Humidity (NTC 1663), Protein (NTC 1556), Total fat (NTC 1162) iron AOAC 944.02. Statistical analysis was performed with ANOVA (P <0.05) and means difference were compared using Tukey (P <0.05). Also, difference between the samples with bilateral Dunet test (ICS 95%).

The statistical comparison was performed with a standard deviation confidence interval of 95%. Excel (Microsoft Office Excel 2003 SP1 11.6355.6360 © copyright 1985 to 2003 microsoft corp.) was used. The analysis of variance (ANOVA) was performed with significance (P <0.05), means were compared using the Tukey test (P <0.05 and showed the difference between the samples, performing a test Dunnet bilateral (95% ICS). The statistical analysis was done using XLSTAT.

Results and discussion

Figure 1. Samples obtained alter the elaboration process

![Beef (R)](image1) ![Buffalo (B)](image2)
The average value for physicochemical and iron content of fortified meat products with dried bovine hemoglobin are shown in Table 1.

The statistical treatment showed no significant differences for the values of fat (%) (R = 14.2352 and B = 9.7446), moisture (%) (R = 64.9434 and B = 65.3612) Protein (%) (R = 13.5347 and B = 14.0219) and pH (B = 7.01 and R = 6.71). Also a significant difference for ash (%) (R = 1.7572 and B = 2.8013) and iron (B = 2.82 mg/kg and R = 2.52 mg/kg) the data obtained exceed the minimum recommendations for minimum intake of iron in Colombia (1,184 mg / kg, ICBF) and Latin American food (1.1 mg/ kg, FAO).

The pH values for beef and buffalo are consistent with those stipulated by Ellas et al (2007) where the sausage meat range is 5.8 to 7.0.

### Table 1. Physicochemical characterization of B and R samples

<table>
<thead>
<tr>
<th>Variable</th>
<th>Samples</th>
<th></th>
<th></th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>B</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>14,2352</td>
<td>± 12,312</td>
<td>9,7446</td>
</tr>
<tr>
<td>Moisture (%)</td>
<td>64,9434</td>
<td>± 8,045</td>
<td>65,3612</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>1,7572</td>
<td>± 0,476</td>
<td>2,8013</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>13,5347</td>
<td>± 6,98</td>
<td>14,0219</td>
</tr>
<tr>
<td>pH</td>
<td>7,01466</td>
<td>± 0,273</td>
<td>6,7163</td>
</tr>
<tr>
<td>Iron (mg/100 g)</td>
<td>2,52 ± 0,125</td>
<td>2,82 ± 0,236</td>
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</tbody>
</table>

For ash, values there was a significant difference between the two results, the product made from buffalo meat, has more minerals, and has higher quantities of iron. Statically was determined that the sample B is significantly different from the sample A, showing a higher iron content of the sample B in relation to R. Also, data obtained in both samples exceed the limits from Colombia and Latin American typical food, with a portion of 100mg, both products.

The beef sausage, would provide approximately 36% more than 100g of conventional product per serving g (levels of absorption into the body are not considered). The quantity of absorption is variable and depends on various factors such as individual's age, sex, type of food according to FAO (2007). Buffalo meat has 53% more iron than required by current regulations. Buffalo product (B) was selected with the best physicochemical and nutritional characteristics, as well as a partial solution to low iron consumption in the population. According to the FAO minimum daily intake should be at least 6 mg.

**Conclusions**

Aviable Iron contents are significantly affected with the addition of bovine hemoglobin (200mg/Kg) to an economic sausage made by select quality cuts from beef and buffalo, especially contents of the buffalo one. Protein levels were increased and saturated fat decreased in relation with beef meat, making it a candidate for industrial economic products like "healthy ", "high iron" or "low fat".

Buffalo product presents healthy physicochemical characteristics respect to Beef product, especially in terms of protein, fat and iron contributions against securities FAO and ICBF requirements. Meat products were obtained with the addition of standardized hemoglobin according to NTC 1325.
Acknowledgements

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References

CEDRES, J. (2002). Chemical composition and physical characteristics of buffalo meat extensively bred in the province of Formosa. UNNE. Faculty of veterinary science. Corrientes.


