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# BLOOD SAUSAGE ("MORCILLA") AS A HIGHLY ACCEPTABLE IRON FORTIFICATION VEHICLE FOR INFANT FEELING.

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## INTRODUCTION

In Central America, as well as in other developing countries, three main micronutrients have been found to be deficient in the diet: Vitamin "A", iodine and iron. These deficiencies have been generally tackled through the fortification of sugar with vitamin "A", salt with iodine and wheat flour with iron. While the first two approaches have proven to be relatively efficient in reaching the rural population, which is the most vulnerable group, the third has presented several difficulties. First, bread consumption in the Central American rural populations is very low (bread is generally substituted by "tortilla"); secondly, the diet of infant rural populations (the most vulnerable group to iron deficiency) does not include products containing wheat flour; thirdly, biovailability of iron source used to fortify bread flour (generally elemental iron), is very low. Consequently, continuous efforts are being made to identify alternatives to improve iron nutritional status of the infant group of the rural, low income families. Different consumption surveys have shown that generally the daily diet of the rural infants (6 months to 2 years) includes a broth, which in most of the cases is bean (black or red) broth, although the use of commercial dried soup mixes, and consomé envelopes have gained some popularity. On the other hand, blood sausage ("morcilla" or "moronga") is a common product in the rural areas of Central America, prepared from heat coagulated swine blood, seasoned with mint, onion, salt, wild marjoram, pepper and bacon, all stuffed in previously well washed swine intestine. Therefore, it was considered interesting to study the possibility of including this rural product containing iron in its most bioavailable form (namely, heme-iron) in the formulation of both, rural home prepared soups, as well as commercial dried soup mixes and consommé envelopes, as a vehicle for iron fortification.

## OBJETIVES

1.- To determine appropriate technological alternatives for the preservation of the blood sausage at the rural level in Central America.

2.- To determine the possibility of including the blood sausage as a vehicle for iron fortification, both in the preparation of commonly home cooked rural soups or broths, and commercial dried soup mixes and consommé envelopes, without significantly affecting their organoleptic acceptability.

3.- To determine the organoleptic acceptability of blood sausage fortified products.

## EXPERIMENTAL METHODS

Blood sausage was prepared at the rural area of Guatemala through the traditional methology, which basically consists in collecting the swinene's blood (as cleanly as possible) during the sacrificing of the animal. The blood is seasoned with well-ground mint, onion, bacon, wild marjoram and pepper. Then it is stuffed in the well- washed large interstine of the animal, which is also turned over and washed with a 4:1 water:vinegar solution. After stuffing and tying the sausage like product is then immersed in boiling water to attain the complete blood coagulation and the desired consistency of the product. Two alternative appropriate technologies were studied for the preservation of the blood sausage at the rural area. One was the smoke-drying of the product in a smoking unit, mantaining the temperature of the smoke heating the hanging sausage at 50° to 60°C. The other one was air drying the blood sausages in an air convection oven at an inlet air temperature of 50° to 60°C. In both cases the treatment was continued until stabilization of the weight of the dried product. Both dried products were evaluated for the fortification of rural home prepared black bean broth. For is purpose, 9 g of finely ground dried blood sausage were added to 500 ml of broth (approx 12% solids), thus yielding a 15 g blood sausage solids per 100 g black bean solids. For the fortification of the commercial dried soup mix and dried consommé, fresh blood sausages were immersed in boiling water until all fat could be separated by decantation. Then, the product was air-dried in a convection oven at an inlet air temperature of 60°C and then finely ground to 200 mesh. Then the deffated, dried and ground product was added at 15% level to two commercial chicken noodle dry soup mixes and at 30% level to commercial dried beef consommé. The organoleptic evaluation of the products was carried out in a panel of 30 semi-trained individuals using the differential organoleptic test. The individuals conforming the panel where mostly women from the rural area.

All chemical and microbiological evaluations were carried out essentially following the AOAC methods. The statistical analysis of the organoleptic data was carried out using the standard analysis of variance F test.

## PRINCIPAL RESULTS

Table the despicts the percent composition of the fresh blood sausage. Its high concentration of heme-iron, is evident thus indicating its potential as an iron fortification vehicle. Through the drying alternatives evaluated, the moisture content of the product was lowered to 7.7 $\pm$ 0.4%, and its heme-iron concentration rose to an average of 410.8 mg%. Therefore, on the average a portion of black beans soup contained 33 mg of heme-iron, enough to cover daily requirements of iron. In the case of the dried soup mix the fortification provided an average of 10 mg of heme-iron per portion, contining an average of 15 to 18% solids. Similarly, in the case of the beef consommé the fortification provided an average of 10 mg heme-iron since a portion contained 6 to 8 g of solids. Assuming 15% absortion of the heme-iron, a portion of dehydrated chicken noodle soup or of beef consommé provide 1.5 mg absorbable heme-iron which is higher than 1 mg iron which on the average is the daily requirement. The organoleptic characteristics of the fortified and non-fortified products studied are presented in Table 2. No statistical difference ($P<0.05$) was detected between the fortified product, when compared with the non-fortified product. Both the fresh as well as the dried blood sausage products were found to comply with the microbiological and chemical Guatemalan standards for this type of products. The dried blood sausages prepared by both drying alternatives studied were found to be stable for at least 4 weeks at room temperature (21°C and 65% relative humidity) packed in paper bags.

## CONCLUSIONS

From the main results summarized before, it is evident that the traditional rural manufactured blood sausage can be successfully used as an iron fortification vehicle both for the traditional rural home prepared black beans broth as well as for the commercial chicken noodle soup mix and the beef consommé envelopes, providing more than the daily iron recommendations per portion in all cases. Since these types of products have been found to be consumed daily by infants in the Central American rural areas, the traditional rural blood sausage can be considered an acceptable iron fortification vehicle for infant feeding. Presently, studies are being planned to determine the biological efficiency of the fortified products as well as the cost of the fortification in process.

**TABLE 1**
**PERCENT COMPOSITON OF THE TRADITONAL BLOOD SAUSAGE PREPARED AT THE RURAL AREA**

| Component | Concentration (%) |
|---|---|
| Moisture | 72.52 |
| Crude protein (N x 6.25) | 16.86 |
| Ether extract | 8.34 |
| Ash | 1.05 |
| Crude fiber | 1.01 |
| Carbohydrates (by difference ) | 0.22 |
| Iron (mg %) | 122.65 |

**TABLE 2**
**ORGANOLEPTIC SCORE OF THE FORTIFIED AND NON FORTIFIED PRODUCTS STUDIED**

| PRODUCT | ORGANOLEPTIC SCORE * |
|---|---|
| Rural black bean broth | 6.15 ± 1.13a** |
| Fortified rural black bean broth | 6.12 ± 1.43a |
| Commercial chicken noodle soup "A" | 6.20 ± 1.76a |
| Fortified commercial chicken noodle soup "A" | 5.93 ± 1.79a |
| Commercial chicken noodle soup "B" | 6.10 ± 1.37a |
| Commercial beef consommé | 5.33 ± 1.35a |
| Fortified commercial beef consommé | 5.98 ± 1.42a |
| | 5.87 ± 1.39a |

* Based on a 1, 3,5,7 hedonic scale.
**Standard deviation of the mean. Different letters indicate a statistically significant difference ($P < 0.05$).