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CORN PROTEIN USAGE IN SAUSAGE MEAT

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INTRODUCTION

In today's world market, animal protein supplies are steadily becoming inadequate to meet the growing demand. Of the world's total protein yield, it has been estimated that about 80% is derived from plant sources, which represents about four times the total protein output of animals, such as in the form of meat and dairy products. Much of this protein, however, is wasted because of the low conversion ratio of plant protein into animal protein. Therefore the need for exploratory research into methods of improving our utilization of plant proteins, so as to complement and supplement animal protein in the diet, has been increasingly stressed.

Every year, Chinese manufacturing produces maize (corn) starch, which also produces a proportionate quantity of raw maize protein. Much of this protein is utilized as animal feed, which represents a considerable waste of the protein resource.

It was noted that this maize protein, in it's unrefined form, contains more than 60% protein. As such, it was considered to have great potential as a protein additive in sausage meat products. To be useful, however, it must be degreased, deodorized, and modified. The purpose of this project, therefore, was to investigate the possibility of processing raw maize protein for use as a sausage additive, with a view towards improving the world supply of protein and reducing the manufacturing cost of sausages.

MATERIALS AND METHODS

The production of de-esterified, deodorized, and modified maize protein was accomplished as follows. Three hundred grams of raw maize protein was subjected to Soxhlet extraction using petroleum ether. Water was then added, creating a two litre dispersion. This was heated at 50°C and stirred with the addition of 2% Na_3PO_4 and NaClO to adjust the pH to a value of 5.6. Dehydration of the mixture was followed by the addition of sufficient water to bring the volume up to two litres. The mixture was then stirred and re-heated at 50°C, before dehydrating and drying the protein substance into its final powder condition.

The water binding capacity of the sample was tested by the JAS standard method. To a five gram dry sample was added 100ml of water, which was set aside for 20 minutes. This was then cooled to 25°C, centrifuged at 3500rpm for five minutes and weighed. The water binding capacity (WBC) was calculated as:

$$WBC = \frac{\text{Residue weight after centrifugation}}{\text{Dry sample weight}}$$

The oil binding capacity was determined by the JAS standard method. Forty grams of refined pork fat was added to a 100g sample of the protein and blended to achieve a homogeneous mixture. This was inserted into a 30mm diameter cellophane casing, heated at 85 to 90°C for 45 minutes and cooled for 30 minutes. This was then formed into 7.62cm sheets, dipped into 1% SUDAN III, flushed and observed for colour under a microscope.

The emulsifying ability of the protein was measured by the JAS standard method. A seven gram sample was blended together with 100ml of water and 100ml of refined soybean oil until a homogeneous mixture was achieved. One hundred ml of the resulting liquid was poured into a 100ml volumetric cylinder. This was set aside for 30 minutes after which the quantity of separated water (dehydrated portion) was directly measured.

The percentages of maize protein used in the various sausages are given in Table 1. A "Ledoc" sausage formulation was used consisting of 75% lean , 18% fat, 7% starch, 3% salt, with flavouring "to taste." Also, 0.02% $NaNO_2$ was added to help preserve and stabilize the product.

The meat was prepared by chopping and salting selected pieces of meat (3% salt, 0.0% nitrite). This was then mixed with the maize protein,stuffed into casings, baked at 50 to 60°C for 40 minutes, boiled at 85 to 90°C for 45 minutes and finally smoked.

Six specially trained sensory panellists were used for the evaluation of sausages. The elasticity, bite resistance, mouth-feel and surface appearance were tested. A rating scale ranging from 10, for "excellent" to 2, for "very poor" was used by the panellists to rank the various sausages. The sample size for each sausage type was 10.

An overall sensory evaluation score was calculated as follows:

$$X = \sum_{i=1}^{n} f_i * x_i/n$$

where: f = scaling factor (f=2 for elasticity, f=2 for bite resistance, f=5 for mouth-feel, f=1 for surface appearance)
x = individual attribute score (see above)
n = 10

RESULTS AND DISCUSSION

The degreased, deodorized, and modified maize protein was found to have a pale-yellow and finely textured appearance. It was non-odorous, and consisted of 80% protein. Furthermore, several improvements in its functional characteristics were also noted, as discussed below.

Water Holding Capacity

The modified maize protein exhibited superior water-holding capacity, as shown by the data reported in Table 2. These results suggest that $NaClO_2$ acts as a strong oxidizing agent which acts on the S-S and S-H bonds of corn protein to form $R\text{-}SO_3$. This then readily combines with water to directly enhance the water holding capacity of the protein. Also, the molecular shape of the protein is altered by handling. The effect of this is to extend the peptide bond, increase the molecular surface area, and to raise the volumetric capacity of the colloid structure, thereby further enhancing the water holding capacity.

Oil Binding Capacity

The oil-binding capacity was determined using a microscope with a magnification power of 50 times. It was found that the modified corn protein combined with pork fat in a manner that exhibited no separation of the fat, as indicated by the Sudan III red-colour test. Therefore, the maize protein was regarded as having an excellent oil binding capacity.

Emulsifying Capability

As illustrated in Table 3, the emulsifying capability of the modified maize protein was found to be superior to that of the unmodified protein. It would appear that the number of exposed water binding sites on the maize protein is increased by the processing treatment.

Sensory Evaluation of Sausages

Results of the sensory panel evaluation of the eight different sausages is presented in Table 4. It was found that sausages coded 1 ,2 and 3 exhibited no significant difference in elasticity, bite resistance, mouth-feel and visual appearance. Sausages coded 4 and 5 displayed no differences from these in terms of bite resistance and mouth-feel, but were paler in colour and were of lower elasticity. Sausages 6 and 7 were of poorer quality in terms of elasticity, bite resistance, mouth-feel, and visual appearance than any of the others above. Sausage No. 8 was found to be fully unacceptable.

CONCLUSIONS

Preparation of a modified maize protein in the manner presented in this paper enhances the functional properties of the protein for the purposes of using this protein as a supplement in sausage manufacturing. Moreover, the protein has a pleasant odour, a good water holding capacity, and a good emulsifying capability. Sausages of high quality can be made using modified maize protein if its content is limited to less than about 10%.

REFERENCES

ANON. 1982. *Meat Research.* Chinese Meat Research Centre. pp.27.

ANON. (Japanese Food Industry Association) 19??. *Food Analysis Methods.* Sinchuar Sci. & Technol. Press. Japan. (translation by Zhengzhor Foodstuff School, China).

GURANOCHEN, L. (ed). 19??. *Theoretical Optimization of Machine Food Processes.* Science Press. China.

Table 1. Quantity of modified maize used in different experimental sausage formulations.

Test number	Quantity added (%)
1	2
2	4
3	6
4	8
5	10
6	12
7	14
8	16

Table 2. Differences in water holding capacities between modified and unmodified maize protein as a function of pH.

pH	Unmodified	Modified
4	265	280
5	257	262
6	272	285
7	299	312
8	301	314
9	302	315
10	303	315
11	303	316
12	304	315

Table 3. Effect of pH on the emulsifying capabilities of modified and unmodified maize protein as exhibited by the dehydration quantities of the JAS emulsification test.

pH	Unmodified (dehydration water,ml)	Modified (dehydration water,ml)
3	8.0	7.0
4	12.5	11.0
5	16.0	14.0
6	14.5	13.0
7	11.5	10.0
8	7.5	6.0
9	6.0	5.0
10	5.5	4.5
11	4.0	3.0
12	3.0	2.2

Table 4. Overall sensory evaluation scores of test sausages.

Sausage Code	Overall sensory score (X)
1	9.8
2	8.6
3	8.1
4	7.3
5	6.5
6	5.8
7	5.4
8	4.2