

THE USE OF GLOBIN FROM HAEMOGLOBIN (GLOBINEX®) IN MEAT PRODUCTS

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SUMMARY

The water-binding capacity (WBC) of the sausages was determined by the laboratory sausage method. The meat protein in the sausages was partially replaced with Globinex®. The sausages were formulated with (WP) or without (WOP) added phosphate. The WBC was expressed as bound water/meat or /meat-protein mixture, respectively.

The weight loss of the ground meat patties was determined as a weight difference between uncooked and cooked patties.

The WBC in WOP-sausages was higher in the Globinex® sausages than in the control sausages. The increase in protein replacement from 1 to 3% did not influence the WBC. In the WP-sausages the WBC was highest in the control sausages and slightly decreased with increasing replacement. This indicates that in the WP-sausages meat is more responsible than Globinex® for the sausage-gel strength than in the WOP-sausages. Raising the ultimate core temperature from 60° to 80°C decreased the WBC in all variables.

The addition of Globinex®, soya protein isolate, or non-fat dry milk, singly or in combination, had essentially the same decreasing effect on weight loss and an increasing effect on the firmness of the patties. The patties containing Globinex® alone were organoleptically the best.

It was concluded that globin from haemoglobin can be used as a meat replacement or extender in meat products without decreasing the WBC, firmness, or organoleptic quality of the products, especially in products without added polyphosphates.

INTRODUCTION

A significant part of blood is used as a feed ingredient or is wasted. The haeme group restricts the use of haemoglobin in most meat products. Autio (1983) developed a method by which heme can be separated from haemoglobin without denaturing the globin. This globin has excellent gel-forming ability and water-binding capacity especially at low pH-values (below 6) (Hermansson and Tornberg 1976). Salt also lowers the functional properties of globin. The emulsifying capacity of globin is not pH-sensitive (Autio et al. 1984a, 1984b). Honkavaara and Tuominen (1983) showed that milk powder and plasma can be replaced with globin in cooked sausage. Globin

had no off taste but sausages containing globin were organoleptically slightly poorer than those with milk powder and plasma. In this study, globin from haemoglobin, Globinex®, which was separated from haeme by a newly made modification (Kauppila, personal communication) of a patented Finnish procedure (Autio et al. 1983a), was tested in cooked sausages and minced meat patties.

MATERIAL AND METHODS

The WBC of the sausages (meat or meat-globin mixture) was determined using the laboratory sausage method of Puolanne and Ruusunen (Puolanne and Ruusunen 1978, Puolanne and Terrell 1983). The method comprises a miniature scale sausage preparation, with high water addition. The amount of added water was adjusted in all the sausages to a level high enough, that a measurable amount of released water could always be detected. The water released after cooking and cooling was manually separated from the sausage after peeling, and the remaining sausage was weighed. The WBC was calculated on the basis of the weight difference between uncooked sausage (without the weight of the casing) and the cooked, cooled and peeled sausage. The WBC was expressed as bound water g/100 g meat or meat-globin mixture, respectively. The recipes of the sausages obtained on the bases of preliminary tests, are presented in Table 1.

Beef and pork lean meats were carefully trimmed of visible fat and connective tissue. The meat protein in the sausages was partially replaced with globin. This was

Table 1. Recipes of the WBC-sausages, g.

| | Control | Globin | | |
|--------|---------|--------|--------|--------|
| | | 1 % | 2 % | 3 % |
| Beef | 60.00 | 49.48 | 38.95 | 28.42 |
| Pork | 60.00 | 60.00 | 60.00 | 60.00 |
| Water | 100.00 | 107.84 | 115.70 | 123.51 |
| Fat | - | 0.09 | 0.17 | 0.31 |
| Salt | 4.40 | 4.15 | 3.91 | 3.66 |
| Globin | - | 2.59 | 5.18 | 7.76 |

Added phosphate 0.55

Table 2. Recipes of the meat patties, g.

| | 1 | | 2 | | 3 | |
|-----------|----------|----------|----------|----------|----------|---------|
| | g | (%) | g | (%) | g | (%) |
| Meat | 1000 | (52.9%) | 1000 | (50.0%) | 1000 | (50.0%) |
| Water | 638 | (33.7) | 638 | (31.9) | 638 | (31.9) |
| NFDM | - | | 62 | (3.1) | 62 | (3.1) |
| SPI | - | | 46 | (2.3) | - | |
| Salt | 24 | (1.3) | 24 | (1.2) | 24 | (1.2) |
| Seasoning | 230 | (12.1) | 230 | (11.5) | 230 | (11.5) |
| Globin | - | | - | | 46 p | (2.3) |
| | 1892 g | | 2000 g | | 2000 g | |
| Meat | 1000 | (51.0 %) | 1000 | (51.0 %) | 1000 | (51.1%) |
| Water | 638 | (32.5) | 638 | (32.5) | 9.1 | (0.5) |
| NFDM | - | | - | | - | |
| SPI | 46 | (2.3) | - | | - | |
| Salt | 24 | (1.2) | 24 | (1.2) | 24 | (1.2) |
| Seasoning | 230 | (11.7) | 230 | (11.7) | 230 | (11.8) |
| Globin | 24.7p | (1.3) | 70.7p | (3.6) | 691.1 l. | (35.4) |
| | 1962.7 g | | 1962.7 g | | 1954.2 g | |

p = powder ; l = liquid

Table 3. The WBC of the sausages (g bound water/100 g meat)

| WOP | | m | | | |
|---------|-----|------|------|------|--------|
| Control | | 47.0 | 45.7 | 50.3 | 47.6 a |
| Globin | 1 % | 58.4 | 56.6 | 58.7 | 57.9bc |
| | 2 % | 59.2 | 58.1 | 58.4 | 58.6 b |
| | 3 % | 56.5 | 55.7 | 56.1 | 56.1 c |

abc = means with different superscript letter in vertical rows are significantly different (p<0.05).

| WP | | m | | | |
|---------|-----|------|------|------|--------|
| Control | | 72.7 | 68.9 | 69.1 | 70.2 a |
| Globin | 1 % | 65.4 | 68.0 | 66.3 | 66.6 b |
| | 2 % | 64.6 | 63.4 | 66.0 | 64.7 b |
| | 3 % | 60.6 | 60.6 | 62.1 | 61.1 c |

abc = means with different superscript letter in vertical rows are significantly different (p<0.05).

m = mean value

Table 4. The WBC in sausages in different ultimate core temperatures (60°, 70°, 75° and 80°C).

| WOP | Control | | m | Globin | | m |
|------|---------|------|--------|--------|------|--------|
| | 60°C | 65.7 | | 63.1 | 66.1 | |
| 70°C | 66.6 | 66.7 | 65.5aA | 65.7 | 67.2 | 66.5aA |
| | 56.4 | 57.6 | | 60.0 | 60.1 | |
| 75°C | 58.1 | 58.0 | 57.5bA | 62.6 | 58.1 | 60.2bB |
| | 53.2 | 51.7 | | 55.3 | 56.6 | |
| 80°C | 56.4 | 52.2 | 53.4cA | 53.6 | 56.7 | 55.6cA |
| | 49.5 | 50.4 | | 51.7 | 53.9 | |
| | 50.1 | 48.0 | 49.5dA | 52.7 | 52.4 | 52.7dB |

AB and abcd = means with different supercript letter in horizontal (AB) and in vertical (abcd) rows are significantly different (p<0.05).

| WP | Control | | m | Globin | | m |
|------|---------|------|--------|--------|------|--------|
| | 60°C | 83.7 | | 83.3 | 76.4 | |
| 70°C | 82.8 | 83.3 | 83.3aA | 74.3 | 74.5 | 75.1aB |
| | 77.4 | 77.5 | | 62.3 | 64.2 | |
| 75°C | 79.5 | 75.6 | 77.5bA | 63.9 | 62.9 | 63.3bB |
| | 71.0 | 71.7 | | 57.0 | 54.7 | |
| 80°C | 74.4 | 69.7 | 71.7cA | 59.2 | 57.1 | 57.0cB |
| | 66.5 | 71.5 | | 49.6 | 51.9 | |
| | 67.8 | 70.3 | 69.0cA | 49.0 | 48.0 | 49.6dB |

AB and abcd = means with different supercript letter in horizontal (AB) and in vertical (abcd) rows are significantly different (p<0.05).

m = mean value

done by replacing meat with a globin-water-fat mixture to achieve the same chemical composition. The sausages were formulated with (WP) or without (WOP) added phosphate. The salt content and the phosphate content were calculated on the basis of raw materials without additives.

In the second test the ultimate core temperature was raised from 60°C by four steps (60°C, 70°C, 75°C and 80°C) and the globin content was 2.0%. The salt content of the sausages was 2.0% NaCl. The phosphate added was a commercial phosphate mixture. The amount of phosphate added was 0.3%.

The WBC was determined in four different sausages (4 globin levels). From each variable three replicates were made. The sausages were made in a random order. The results were analyzed by one-way variance analysis with Tukey's test.

The weight loss of the ground meat patties was determined as a weight difference between uncooked and cooked patties. The firmness was determined by a compressometer. Globin was used to replace non-fat dry milk (NFDm) and/or soya protein isolate (SPI) on a protein basis. Meat was not replaced. The organoleptic test was done. The recipes of the meat patties are presented in Table 2.

RESULTS

Sausages

The WBC increased when globin was used in the WOP-sausages (Table 3). The increase in protein replacement from 1 to 3% did not influence the WBC. The WBC decreased when globin was used in the WP-sausages (Table 3). The WBC decreased with increasing protein replacement. Raising of the ultimate core temperature from 60°C to 80°C

decreased the WBC in all variable (Table 4). In the WOP-sausages the WBC was higher in the globin sausages than control sausages. In the WP-sausages the WBC was lower in the globin sausages than control sausages.

Meat patties

There were no differences in weight losses caused by the addition of globin, SPI or NFDm, singly or in combination (Table 5). The results showed that the patties containing globin alone or in combination had better firmness than patties without globin (Table 6). The results showed that the patties containing globin alone were organoleptically the best (Table 7).

DISCUSSION

The effects of the use of globin were different in WP- than in WOP-sausages. The reason for that is most probably

Table 5. Weight losses of the meat patties, %.

| Recipe | m | | | |
|--------|------|------|------|------|
| 1. | 14.2 | 12.8 | 14.2 | 13.7 |
| 2. | 14.3 | 9.4 | 11.4 | 11.7 |
| 3. | 13.6 | 10.0 | 11.5 | 11.7 |
| 4. | 14.3 | 10.5 | 11.8 | 12.2 |
| 5. | 15.0 | 11.7 | 11.5 | 12.7 |
| 6. | 13.6 | 12.1 | 12.5 | 12.7 |

m = mean value

Table 6. Firmness of the meat patties. Lateral pressure, kg.

| | m | | | |
|----|------|------|------|--------|
| 1. | 6.0 | 6.6 | 7.5 | 6.7 a |
| 2. | 13.5 | 10.9 | 12.7 | 12.4 b |
| 3. | 15.5 | 13.8 | 15.2 | 14.8 c |
| 4. | 19.4 | 14.6 | 15.6 | 16.5 c |
| 5. | 16.8 | 13.8 | 12.9 | 14.5 c |
| 6. | 19.6 | 15.3 | 16.1 | 17.0 c |

abc = means with different superscript letter in vertical rows are significantly different ($p < 0.05$).
m = mean value

Table 7. Organoleptical evaluation test of the meat patties.

Ranking test
6 panelists

| | |
|----|------|
| 1. | 84 a |
| 2. | 84 a |
| 3. | 63 b |
| 4. | 57 b |
| 5. | 58 b |
| 6. | 32 c |

abc = means with different superscript letter in vertical rows are significantly different ($p < 0.05$).

more due to the effect of polyphosphates on meat protein system than on the globin. When meat was replaced with globin, the polyphosphates could react with a smaller amount of meat resulting therefore a decreased WBC. Polyphosphates also raise the pH-value of the batter, which also could have a negative effect on globin, but the opposite on the meat system. In WOP- sausages the

globin proteins had approximately the same functional properties as meat proteins. In meat patties, which were also naturally prepared without added polyphosphate, and where not meat but other extenders were replaced, the functional properties of globin was equivalent to soya protein or milk protein.

It was concluded that globin from haemoglobin can be used as a meat replacement or extender in meat products without decreasing the WBC, firmness, or organoleptic quality of the products, especially in products without added polyphosphates.

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