EFFECT OF SUBSTITUTING FAT WITH PEA FIBER ON THE FUNCTIONAL PROPERTIES OF EMULSION TYPE SAUSAGE MODELS

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SUMMARY. The purpose of this work was to investigate the effect of replacing most of the fat with fiber in cooked, emulsion type sausage models.The results show that addition of fiber has a positive effect on the water holding capacity, but even at a replacement rate of half of the fat, this resulted in sausages with a softer and less elastic texture. When sausages were heat treated up to 95C, this did not affect the cooking loss very much.Overall, replacement of at least one forth of the fat with fiber did not essentially change the properties of the sausage, so pea fiber seems to be a promising ingredient to be used in low-calory meat products.

INTRODUCTION: The significance of fat and fiber in the diet is well established. Thus the lack of fiber in the diet as well as high contents of especially animal fats is made responsible for many diseases in the Western World (1). Consumer demands for more healthy foods have been taken up by the food industry through marketing of various products with high content of fiber and/or low fat content. However, the addition of fiber to meat products is still fairly uncommon.

The isolation of fiber-rich fractions from hulled peas has resulted in fiber products with functional properties, which far exceed the traditionally available fibers. This makes it possible to use fibers as an ingredient and at the same time to enrich the product.

The purpose of this investigation has been to examine how replacement of fat with fiber and water influences the functional properties of an emulsion type sausage subjected to various conditions.

MATERIALS AND METHODS:

Production of meat emulsion and sausage model.The meat emulsion was produced according to a very basic recipe, with very few ingredients in order to avoid the influence of too many extraneous factors on the final results. The ingredients were lean pigmeat trimmings, back-fat, nitrite salt (i.e. salt containing 5 g sodium nitrite per kg.), water, ice and a commercial pea fiber product with a fiber content of 47 per cent.

Visible fat was removed from the trimmings, after which meat and fat was diced and chopped individually. All ingredients (except water and ice) were chilled overnight, and the ingredients were then ground and mixed until the emulsion had a temperature of 14-16C. The emulsion was then stuffed in artificial casing (Ø 25mm). Weight and length were measured in order to attempt to produce sausages with uniform densities. The sausages were finally inserted in polyethylene casings so that moisture could not be lost or gained during heating. The sausages were heated in an ordinary water bath. After heating the sausages were stored overnight at 2C.

The following anayses were made: pH, measurement of cooking loss, centrifugal loss, as well as texture determinations. Determinations of protein, fat and moisture were also made. Three experiments were made. An outline of these are shown in the table below:

Experiment no.	1	2	3
Fiber content(%)	0-0.5-1-2-3	2	2
Water/fiber ratio	6	4-5-6-7	6
Cook temp.	75C	75C	75 or 95C

Table 1. Variations in ingredients and cooking temperatures in the 3 experiments.

Experiment 1 was done in order to show the influence of degree of replacement of fat with fiber and water, as well as the effect of chill and freezer storage.

Experiment 2 was done to show the influence of altering the water/fiber ratio.

Experiment 3 was done to show the influence of high cooking temperature.

Measurements of cooking loss, centrifugation loss, water holding capacity and texture have been described earlier (2)

RESULTS AND DISCUSSION:The results of the three experiments are tabulated below:

Fiber content,%	0	0.5	1	2	3
Back-fat replaced,%		12	24	49	73
pH	5.60	5.59	5.65	5.68	5.69
Water in sausage,%	59.9	64.3	66.3	72.2	76.5

Cooking loss,%	7.4a,b	7.1a,b	7.1a,b	6.6a	7.5b
Chill storage, 2 weeks at +5C	0.26c	0.21c	0.23c	0.50c	1.16c
Freezer storage, 2 weeks at -20C	0.55d	0.54d	0.73d	0.67d	1.09d
Centrifugal loss%					
No storage	5.6e	6.4e	6.1e	8.0f	12.4g
Chill storage	4.8e	5.5e	6.6e,f	8.0f	11.9g
Freezer storage	7.1f	8.6g	11.2h	15.4i	24.0j
Water holding capacity					
No storage	50	52.4	55.4	58.8	59.0
Chill storage	50.2	53.1	54.3	57.9	57.5
Freezer storage	47.6	49.7	49.2	50.3	45.7
Yield strength N/sq.cm.					
No storage	12.6k	11.9l	8.7m	7.5n	6.1o
Chill storage	14.2p	13.8p	10.0q	9.8q	8.1r
Freezer storage	12.9k,p	13.1p,l	10.2q,l	11.4k,l	9.3m
Elasticity N/sq.cm.					
No storage	26.0s	26.6s	20.2t	18.4t	13.4u
Chill storage	29.8v	30.7v	22.5t	21.4t	18.1s
Freezer storage	29.0w	31.1v,w	26.0x	30.4w	23.3x

Table 2. Influence of fiber content on properties during chill and freezer storage. Values with different lettersuffix are significantly different (p=0.05)

Water/fat-ratio	4	5	6	7
Back-fat replaced %	35	42	49	56
pH of emulsion	5.56	5.51	5.53	5.55
Centrifugal loss %	10.9a	14.2b	11.6a	12.2a
Water holding capacity	54.7	52.4	57.3	58.5
Yield strength N/sq.cm.	12.4c	10.2d	9.4d,e	9.0e
Elasticity N/sq.cm	22.4f	19.6f,g	20.0f	17.7g

Table 3. Influence of water/fiber ratio and properties. Fiber content is 2% in all groups. Values with different lettersuffix are significantly different (p=0.05)

Cooking temp.,C	75	95
Cooking loss,%	6.2a	5.9a
Centrifugal loss,%	8.3b	8.1b
Water holding capacity	59.6	60.1
Yield stress,N/sq.cm.	9.6c	9.1c
Elasticity,N/sq.cm.	19.7d	17.7d

Table 4. Influence of cooking temperature on properties.Values with different lettersuffix are significantly different (p=0.05)

As will be seen from table 2, replacement of fat with fiber up to 3% does not affect the cooking loss. Although there obviously is a difference in weight loss between chilled and frozen samples, the loss in samples with same treatment remains constant, regardless of the fiber content. However, centrifugal losses increase with increasing fiber contents.

Again, freezing as such increases the loss, as could be expected. The results of the measurements of water holding capacity are not very consistent, except that it decreases if a sample is frozen. Generally, yield stress and elasicity increase on chill and freezer storage, but increased fiber content decrease the results, i.e. the sausages get less elastic and easier to break with higher fiber contents.
Table 3 indicates that an increased water/fiber ratio, from 4 to 7, does not affect the cooking loss, but both yield stress and elasticity decrease. If the cooking temperature is increased, cf. table 4, there is virtually no difference in the losses, so at least up to 95C the final cooking temperature is not critical for the quality.
CONCLUSIONS: It is possible to replace at least up to 24% of the fat in an emulsion type sausage without significant deterioration of the properties. If replacements are larger, this will result in products with lower yield stress and elasticity, i.e. the sausage will be less firm and elastic. Normally a higher cooking temperature results in a decrease in water holding capacity. Cooking losses remain unaffected if the temperature is increases to 95C in emulsion type sausage containing 2% fiber.

REFERENCES:

- (1) A sientific status summary by the Institute of Food Technologists'expert panel on food safety & nutrition and the Committee on Public Information. (1979) Food Technology 33:35

- (2) Thomsen, H. Harding and Zeuthen, P.(1988) Meat Science,22:189.