S7P41.WP

PROTEIN HYDROLYSATES AS FUNCTIONAL INGREDIENTS IN A MEAT EMULSION MODEL.

P. ZEUTHEN and C. WAADE

Department of Biotechnology, Block 221, The Technical University of Denmark, DK-2800 Lyngby, Denmark

INTRODUCTION

Comminuted meat products such as wieners are produced by heat treatment of a homogeneous meat emulsion. The main ingredients are lean meat trimmings, fat, water and curing salt. In addition certain binders and extenders such as hydrocolloids and a variety of plant proteins are added in order to improve the fat and water holding capacity of the system (Mittal and Usborne, 1985).

However the production of substantial amounts of by-products in slaughterhouses form an under-utilized source of expensively produced animal protein. The by-products can constitute an economic as well as an environmental problem. For these reasons it would be advantageous if the by-products, a potential protein source, could be utilized in the manufacture of meat products as functional ingredients on equal terms as the above mentioned binders and extenders.

Lawrie and Ledward (1986) state that an amount of protein equivalent to 1/8 of the total amount of meat of a carcass, is used as pet food, unedible products or is discarded. Hence it follows that there lies a substantial potential in a better utilization of proteins from meat animals.

In order to make the best possible use of by-products a process was developed to extract proteins from various slaughter offal from pigs. The process, which is not described here, consists of a heat-treatment and an enzymic hydrolysis.

It was the purpose of this investigation to report on the behaviour of four different hydrolysates as functional ingredients in meat emulsions.

MATERIALS AND METHODS

The meat emulsion was produced according to a very basic recipe with very few ingredients in order to limit the amount of extraneous factors on the final results. The sausages were analyzed for: centrifugation loss, cook loss and water holding capacity according to Thomsen and Zeuthen (1988).

Elasticity and breaking strength were measured on an INSTRON Universal Testing Machine, model 4301 using instrumental texture profile analysis according to the method of Klettner, (1989) with the following modifications: 100N loadcell; sample dimensions: cylinder with diameter=13mm, height=15mm; speed of crosshead=50mm/min, 80% compression.

In addition determinations of protein, fat, moisture, salt and pH were made to ascertain the composition of the recipes.

Furthermore the products were evaluated by a sensory panel using a multiple comparison procedure (Land and Shepherd, 1984). The differences being expressed on a 15cm graphic scale. It was analyzed by measuring the distance along the line. This means that a high number (maximum 15) is equal to a high degree of the quality trait in question.

The experiments were made according to Table 1.

As indicated in Table 1 each batch included an unsubstituted control emulsion, in order to have a standard of reference to evaluate the effect of substituting increasing amounts of hydrolysate. In the following part of this contribution the unsubsituted emulsion is termed U.

The results were analyzed using one-sided analysis of variance, except for the sensory evaluation which was analyzed by two-sided analysis of variance.

RESULTS AND DISCUSSION

As it is shown in Table 2, cooking loss is significantly reduced by substituting 15% of lean meat by hydrolysate. At the two other levels of substitution, a gradually increase in cooking loss appears.

The same tendencies as for the cooking loss is seen. At the 15% level of substitution the hydrolysate actually reduces centrifuging loss. Higher levels of substitution gradually increases the centrifuging loss.

The same general tendencies naturally occur: at the 15% level of substitution an improved water-holding capacity is seen, the 30% level is a middle situation where some of the hydrolysates are as good as the unsubstituted emulsion, some better. At the 45% level of substitution a general decrease in the water-holding capacity appears.

In Tables 5 and 6 the results from the textural assessments are presented.

At the 15% level of substitution no significant differences (5% level) exist between the unsubstituted emulsion and the emulsions with hydrolysates. At higher levels of substitution the breaking strength decreases linearly (r=0.9521-0.9981)

Elasticity is reduced (5% level of significance) at all levels of substitution except for hydrolysate D (produced from a non-skeletal by-product) on the 15% substitution level. However, this was not shown in the sensory evaluation. Elasticity decreases gradually as the substitution level increases.

In order to asses the organoleptic qualities of the substituted products a sensory evaluation was performed. The results are presented in Table 5.

Table 7 shows that it was not possible for the seven judges to separate an unsubstituted product from the product with 15% of the lean substituted with hydrolysate. In most cases it was possible for the judges to separate the 30% substituted from the 45% substituted.

It follows, that a product with 15% lean substituted for hydrolysate is organoleptically acceptable, whereas higher levels of substitution confers adverse effects on the texture and colour of the products.

CONCLUSION

The presented results clearly show that the level of substitution have a decisive effect on the functional properties of the meat emulsions.

If one only were to consider cooking loss, centrifuging loss and water holding capacity as the important functional properties it would be possible to substitute lean meat proteins for hydrolysates up to the 30% level of substitution.

However the instrumental texture measurements and the sensory evaluation shows that a level of substitution of 15% is acceptable for preservation of unchanged taste, texture and appearance.

It was not possible to establish any methodical difference between hydrolysates produced from different by-products. However the hydrolysate D, produced from skeletal offal, seemed to have the best capability of colour-retention at the higher levels of substitution.

Thus, there seems to be potential application of upgraded slaughterhouse offal as functional ingredients in comminuted heat-treated meat-products.

REFERENCES

KLETTNER, P.G. 1989. Relationship between Measured Firmness Values and Sensory Impression when chewing Frankfurter Type Sausage. *Fleischwirtschaft.* 69(2):225-226.

LAND, D.G., and SHEPHERD, R. 1984. Scaling and Ranking Methods. In: PIGGOT, J.R. (ed). *Sensory Analysis of Foods.* Elsevier Applied Science Publishers.

LAWRIE, R.A., and Ledward, D.A. 1986. Edible Protein Recovery and Upgrading of Meat Packinghouse Waste. In: PEARSON, A.M., and DUTSON, T.R. (eds). *Advances in Meat Research, Vol. 5.* pp.231-260. Elsevier Applied Science. London. New York.

MITTAL, G.S., and USBORNER, W.R. 1985. Meat Emulsion Extenders. *Food Tech.* 39(4):121-130.

THOMSEN, H.H., and ZEUTHEN, P. 1988. The influence of mechanically deboned meat and pH on the water holding capacity and texture of emulsion type meat products. *Meat Sci.* 22:189-203.

Table 1. Outline of experiments. A.B,C,D refers to the raw material from which the hydrolysates were made: A-C mainly from skeletal raw materials; D from non-skeletal raw material.

Batch no.	I	II	III
Amount of lean meat protein substituted (%)	0.15	0.30	0.45
% fat	25	25	25
Type of hydrolysate	A,B,C,D	A,B,C,D	A,B,C,D

Table 2. Batch I-III. Mean-values of cooking loss %. Each value represents an average of a minimum of 5 measurements. Values with different indices are significantly different on the 5% level. A,B,C,D: refer to explanation in table 1.

COOKING LOSS %. BATCH I-III.			
Emulsion code.	I(15% substituted)	II(30% substituted)	III(30% substituted)
U	8.31a	8.07a	8.14a
A	7.65b	8.06af	10.75f
B	7.89b	9.38c	10.47f
C	7.62b	8.93ce	9.27e
D	6.02c	11.41d	10.85f

Table 3. Batch I-III. Mean-values of centrifuging loss %. Each value represents an average of a minimum of 5 measurements. Values with different indices are significantly different on the 1% level. A,B,C,D: refer to explanation in table 1. A,B,C,D: refer to explanation in table 1.

CENTRIFUGING LOSS. BATCH I-III.			
Emulsion code.	I(15% subsituted)	II(30% substituted)	III(45% substituted)
U	9.85a	8.53ac	8.40af
A	8.31b	7.84bdc	12.22g
B	7.05b	8.67c	12.69g
C	7.26bh	5.88dh	8.00fh
D	8.16bi	9.35cgi	10.40eg

Table 4: Batch I-III. Mean-values of water-holding capacity loss %. Each value represents an average of a minimum of 5 measurements. Values with different indices are significantly different on the 5% level. A,B,C,D: refer to explanation in table 1. A,B,C,D: refer to explanation in table 1.

WATER-HOLDING CAPACITY. BATCH I-III.			
Batch code.	I(15% subsituted)	II(30% substituted)	III(45% substituted)
U	46.43a	47.27ae	47.47a
A	48.32b	49.10bd	44.93gh
B	49.16bc	46.82e	40.39i
C	48.81bc	48.41cde	45.91ag
D	49.32c	44.08f	43.61fh

Table 5. Batch I-III. Mean-values of measurements of breaking strength. Each value represents an average of a minimum of 5 measurements. Values with different indices are significantly different on the 5% level. A,B,C,D: refer to explanation in table 1.A,B,C,D: refer to explanation in table 1.

BREAKING STRENGTH [N]. BATCH I-III.			
Batch code	I (15% substituted).	II (30% substituted)	III (45% substituted)
U	11.91a	13.03a	13.10a
A	10.73a	6.02b	2.21c
B	11.67a	6.29b	2.30c
C	11.86a	6.18b	2.70c
D	13.13a	5.59b	3.44d

Table 6. Batch I-III. Mean-values of measurements of elasticity. Each value represents an average of a minimum of 5 measurements. Values with different indices are significantly different on the 5% level. A,B,C,D: refer to explanation in table 1. A,B,C,D: refer to explanation in table 1.

ELASTICITY [mm]. BATCH I-III.			
Emulsion code.	I (15% erstatsess.wptet)	II (30% erstattet)	III (45% erstattet)
U	4.20a	4.14a	4.33a
A	3.30c	3.00b	2.76d
B	2.92b	2.82b	2.60d
C	2.62b	2.46b	2.57bd
D	4.10a	2.35bd	2.51d

Table 7. Sensory evaluation. Values (columns) with different indices are significantly different at the 5% level. The substitued emulsions was prepared with hydrolysate D.

	Unsubstituted (designated)	Unsubstituted (coded)	15% substituted	30% substituted	45% substituted
Off-odour	3.10a	3.33a	5.03a	9.19b	11.10b
Pink colour	11.58a	11.55a	10.62a	6.44b	0.33c
Grittiness	0.07a	0.27a	1.29a	2.88a	6.83a
Cohesiveness	13.91a	13.94a	12.64a	7.31b	3.22c
Off-taste	0.06a	1.23a	0.58a	4.41a	5.22a