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THE EFFECT OF NON MEAT PROTEINS ON THE EMULSION CAPACITY OF MEAT PROTEINS.

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INTRODUCTION

The technical quality of emulsion sausages is mainly determined by the properties of the emulsion formed during the chopping process. These properties depend on many factors, the method of mixing, chopping etc., but also to a large extent on the protein raw material - mainly meat but even other animal or vegetable proteins.

When assessing the quality of emulsions prepared by different proteins one has to distinguish between at least three different properties:

The emulsion capacity: The amount of fat which a given amount of protein is ablt to emulgate.

The emulsion stability: The amount of fat which separates in a given time.

The emulsion heat stability: The amount of fat which separates after a specific heat treatment.

It is well known that different types of meat differ very much with respect to these properties. It is also known that a high emulsion capacity is not always correlated with a good heat stability of the emulsion.

But how the properties of one type of meat is affected by the presence of other types and of non-meat protein is not so well known. Therefore, we started work to evaluate the emulsion properties of such mixture. Emphasis was placed on the heat stability as heat-treated sausage is the most common sausage type in Sweden. Some results of the preliminary experiments are reported in this paper.

EXPERIMENTAL

Protein raw material. The following meat types were used: beef skeletal muscle from the hind leg, pig's diaphragm and pig's heart. The samples were trimmed free from fat and connective tissues and ground twice. The non-meat proteins were as follows:

A soy protein isolate (Promine D, Central Soya).
A texturized soy protein, processed during rather strong heat conditions (TVP, Acher Daniels Midlands).
Sodium caseinate (A/S Lindano, Denmark).
Blood plasma. Cattle blood was centrifuged at 1,500 g for 15 min., the upper layer was decanted and used.

The raw materials were analysed for water, fat, and total protein by standard methods. Salt-soluble protein was determined as the protein soluble in 0.75% NaCl-solution.

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Fat raw material. Raffinated soy bean oil (AB Karlshamns Oljefabriker, Sweden).

Determination of emulsion capacity. The experiments were carried out with a constant amount of water, salt and protein (100 g) in a 400 ml flask fitted to an Omnimixer (Sowal). The emulsification was performed with a 6-bladed stirrer at a rate of 10,000 rpm. The salt concentration was 0.75% in the water phase.

Before adding fat the meat was dispersed for 1 min., when using non-meat protein the dispersion time was extended to 45 min. Fat was added at a rate of 1 ml/sec. until the formed emulsion collapsed. The collapsing point was easily determined by a rapid change in the pitch of the motor sound. The amount of emulgated fat was determined by weighing. The method described is a slight modification of that given by Swift (1).

Determination of the heat stability of emulsion. The method used was essentially that of Inklaar and Fortuin (2). The same apparatus as for determining emulsion capacity was used. A constant amount of fat was added (105 or 150 g). This amount corresponded to about 75% of the emulsion capacity of 0.5% respectively 1% of beef muscle meat. 60 g of the emulsion was transferred to a 135 ml centrifuge tube and heated at 85°C for 30 min. The tube was then centrifuged at 1600 g for 15 min. The separated fat was determined by weighing. By adding Sudan red to the fat it was easy to determine the border line between fat and water.

RESULTS AND DISCUSSION

The composition of the different proteins used in the investigation is shown in Table 1.

Product	Protein %				
	Water %	Fat %	Total (A)	Salt soluble (B)	$\frac{100 \cdot B}{A}$
Beef muscle	75.2	2.5	21.2	6.4	30.2
Pig's diaphragm	71.3	10.5	17.5	9.3	53.2
Pig's heart	79.2	2.2	17.1	4.5	26.3
Promine D	5.8	-	84.7	16.7	19.7
TVP	6.1	-	50.9	3.5	6.9
Sodinol	4.0	-	79.6	69.0	86.7
Blood plasma	-	-	7.4	7.1	96.0

Table 1. Composition of different meat and non-meat protein raw material.

The total protein content of the different samples is of minor interest as of course it is dependent on the water content and therefore much lower in the natural samples than in the dehydrated ones. It is the amount or proportion of salt soluble protein that is of importance as it is generally assumed that it is this type of protein that is responsible for the emulsification. From Table 1 it is evident that on a protein basis Sodinol and blood plasma should be the most effective emulgators and that the soy proteins should have much less effect.

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The emulsion capacity. The emulsion capacity was determined for the protein samples at total protein concentrations between 0.1 and 0.5%. The results are shown in Figure 1.

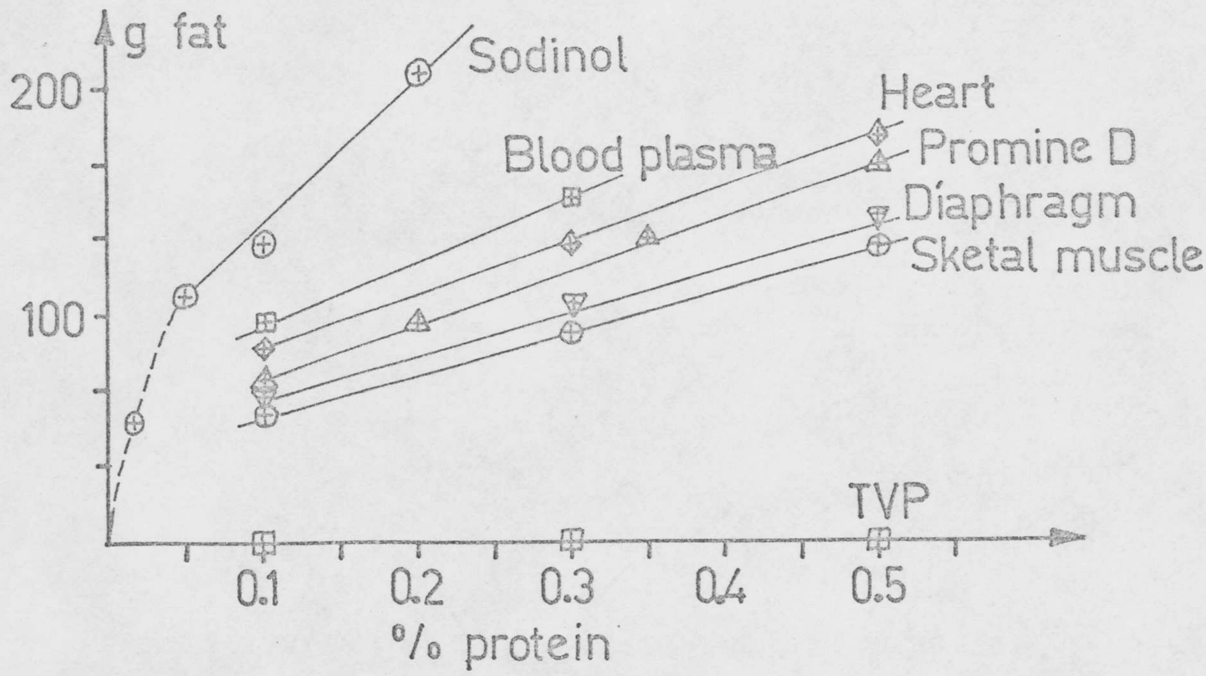

Figure 1. The emulsion capacity of different meat types and non-meat proteins at different protein concentrations.

The greatest emulsion capacity was shown by Sodinol that was able to emulgate twice the amount of fat than any of the meat samples. Blood plasma also had a higher capacity. Surprisingly, among the meat samples the heart had the highest emulsion ability and skeletal muscle the lowest. One of the soy proteins, Promine D, had a rather high capacity to emulgate fat but the other, TVP, was completely devoid of this ability. By comparing Table 1 and Figure 1 one may say that the emulsion capacity of the samples was roughly correlated with salt solubility.

The emulsion capacity of a mixture of a meat sample and a non-meat protein was found to be the sum of the ingredient as shown by Figure 2.

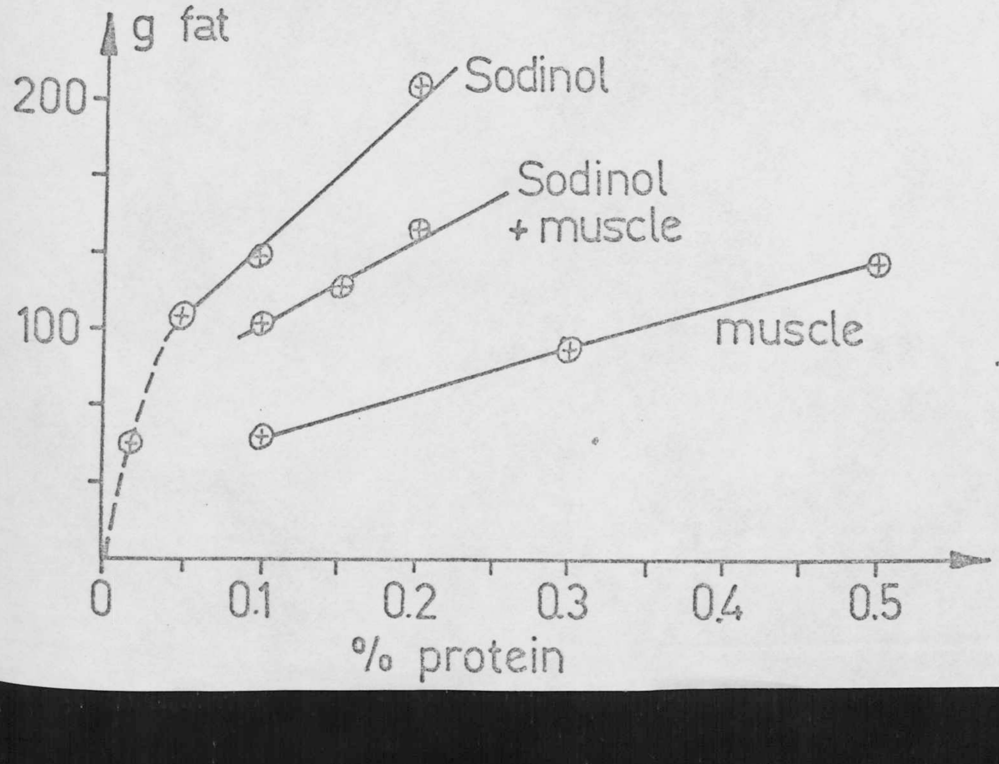

Figure 2. The emulsion capacity of skeletal muscle, Sodinol and a mixture of muscle and Sodinol (50:50) at different total protein concentrations.

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Sodinol and other non-meat proteins the use of which is often recommended to compensate inferior emulsion capacity of some meat types has therefore only an additive effect, not a fortifying one.

The heat stability. When testing the effect of different raw material on the heat stability of emulsion two sets of experiments were performed. In one set the different meat types were mixed with different amounts of Sodinol or Promine D at a total protein content of 0.5% of 1.0%. In the other set diaphragm or heart tissue was mixed with the different non-meat protein preparations at a total protein content of 0.5%.

The heat stability of the emulsion was not affected by the protein content up to 5%. But it was affected for each meat type by the non-meat protein used.

In Figure 3 the effects on diaphragm emulsion are shown. At low proportions of non-meat protein the largest stabilizing effect was shown by blood plasma, but when the part of non-meat protein exceeded 30% of the total protein content Sodinol became better. Promine D had a much smaller stabilizing ability and TVP had none at all.

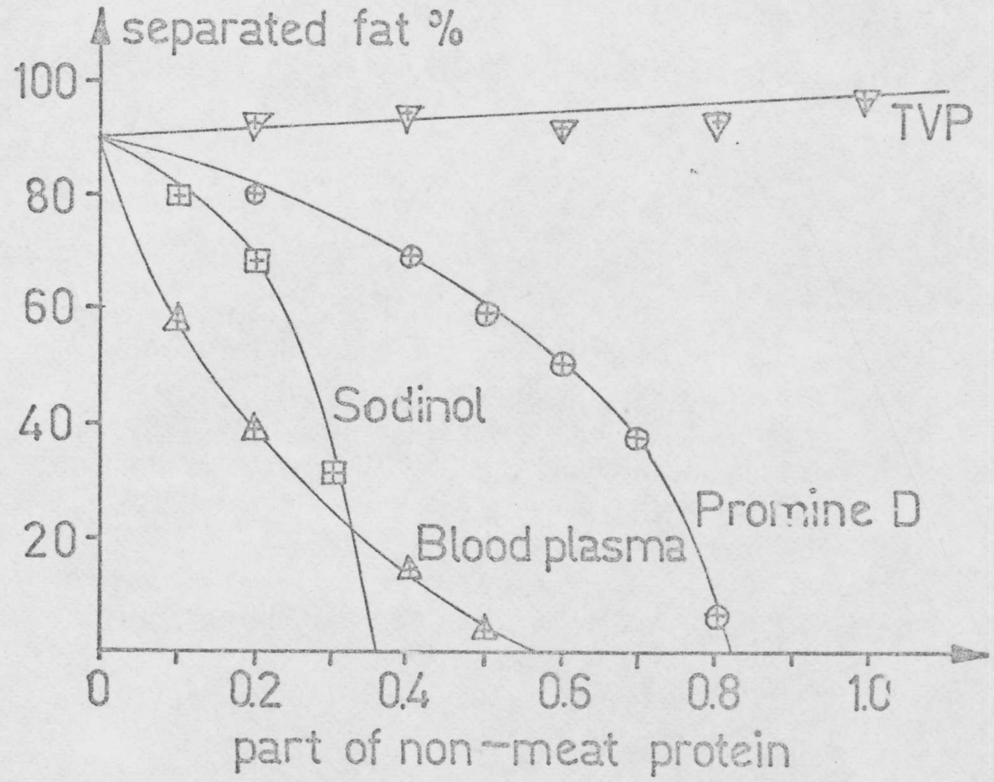

Figure 3. The effect of non-meat proteins on the heat stability of emulsions of pig's diaphragm. The total protein content was 0.5%.

A non-meat protein had a different stabilizing effect on different meat types as shown by Figure 4. E.g. Sodinol had, even in small amounts, a pronounced effect on the heat stability of an emulsion formed by beef skeletal muscle but only a very weak effect on emulsions made of pig's heart.

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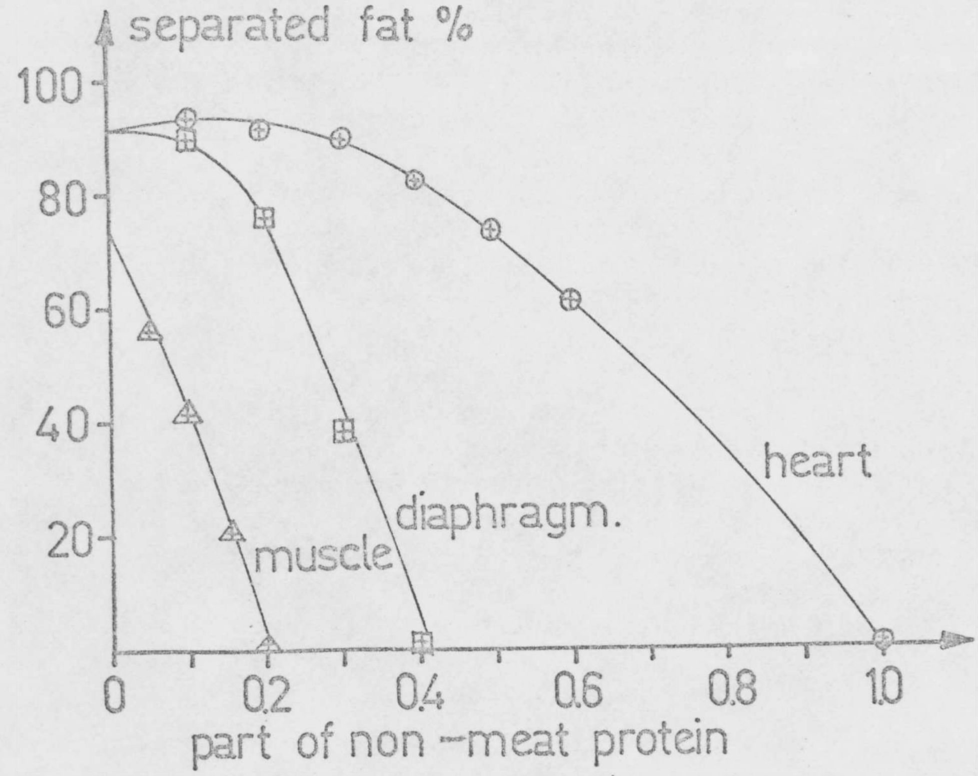

Figure 4. The effect of Sodinol on the heat stability of emulsions of different meat types. The total protein content was 1.0%.

The technique used by us to investigate the emulsion capacity and heat stability differed in several respects from those used in a factory.

It is almost certain that the mechanical treatment in the Omnimixer was quite different from that in a chopper. Furthermore, we used a liquid fat, soy bean oil instead of lard or tallow and this exchange may have had some effect on the results. Anyway, it affected the consistency of the emulsions.

The salt concentration used was lower than the one we normally use; 0.75% in the water phase instead of 2-3%. This, together with the low protein amount used, resulted in a much lower effective protein concentration in the emulsion than in a normal sausage.

But even if it is difficult to transfer the laboratory results directly to the factory the experiences obtained are of practical interest.

Different types of meat had different capacities to emulgate fat but this property was not adequate to classify them as raw material for sausage production, the heat stability of the emulsion also had to be taken in account.

These two properties are not always connected with each other as they depend on different mechanisms. The capacity to emulgate is determined by the amount of soluble protein but the heat stability depends on the strength and conformation of the protein matrix formed during the heat treatment. This difference is clearly shown by comparing skeletal and heart muscle. The former had a lower emulsifying capacity than the latter but gave emulsions of much better heat stability. This condition is well known from practise and is the reason why only small proportions of heart muscle may be used in emulsion sausages.

The results also showed that different non-meat proteins differed very much in their ability to effect the emulsion qualities of meat. In the practical range blood plasma was most effective followed by caseinate. The soy protein appared not to be so effective as its reputation would have. One of them, TVP, had practically no effect at all, which may be ascribed to the very hard heat treatment it is usbmitted to during the manufacturing.

One other finding that may be of direct practical interest was that the effect of a non-protein on meat was highly dependent on the meat type. Meat with good emulsification properties was greatly improved by the addition of e.g. blood plasma or caseinate but meat with inferior emulsification properties such as heart muscle was not improved at all or only to a slight extent. One cannot perform miracles with poor raw materials by using additives.

References

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