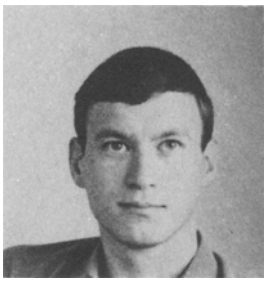

Economic Considerations on the Use of Vegetable Proteins in Danish Meat Products

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ABSTRACT

Use of vegetable proteins in meat products in Denmark is discussed with special reference to economy. Aspects of price vs. quality also are discussed, and performance criteria in the evaluation of vegetable protein products are proposed. Examples are given of recipe optimization with soy protein products, and finally the market perspectives are outlined. It is emphasized that no conflict is seen between the use of vegetable proteins in meat products and agricultural or consumer interests.

DANISH MEAT PRODUCTS

The Meat Processing Industry holds a strong position in Danish export statistics. Thus, in 1977 Denmark exported 540,000 tons of pork meat products at a value of 6.1 billion Dkr., which is 10% of the total Danish export value. This reflects the fact that measured by turnover, meat processing as a whole is the biggest industry in Denmark.

The reason for emphasizing the importance of the meat exports is that it has compelled certain uniform characteristics on the processing industry such as a high degree of competition, large production units, and a high level of technology and hygiene. All these characteristics are important in relation to the use of vegetable proteins.

Concerning the domestic market, we can add a liberal food legislation to the above characteristics permitting the use of vegetable protein products up to a 3% addition level without declaration and above 3% with quantitative declaration. Fixed meat product standards do not exist. Thus, there is no prescribed ingredient list or minimum limit of meat content. These liberal rules have undoubtedly favored introduction of vegetable proteins in Denmark.

USE OF VEGETABLE PROTEINS

Today the use of vegetable proteins is well established in the Danish Meat Industry. Therefore, in general the task of a soy protein supplier is not to explain why to add functional proteins, but rather to convince the customers of the superiority of his products compared to other competitive protein products.

TABLE I

Commercial Vienna Sausage Declaration

Ingredient	%
Beef-pork	65
Water	25
Potato-wheat flour	3
Salt, aroma, spices	3
Milk protein	2
Vegetable protein	2
	100

The term "vegetable proteins" is in fact synonymous with soy proteins, of which the types most commonly used in meat products in Denmark are concentrates at 6.5 to 8.5 D.Kr/kg, isolates at 13 to 14, extruded flours at 5 to 6, and extruded concentrates at 8 to 9 D. Kr/kg.

Speaking of economy, it is important to remember that these soy proteins are not the only functional proteins on the market. In practice, the optimal economy is often obtained by using a combination of soy proteins and other functional ingredients. This is demonstrated, e.g., by using soy protein concentrates such as DAN-PRO-H together with sodium caseinate in emulsion type products. Another example is the recent introduction of low priced skimmilk replacers based on soy proteins and whey powder. Table I shows an example of how the ingredients may be combined in an actual sausage formulation.

ECONOMIC EVALUATION OF SOY PROTEINS

Although economy is undoubtedly a major motive for using soy proteins, this subject seems to have been a stepchild in the vast literature concerning the application of soy proteins.

Most papers confine themselves to a cost calculation on a specific meat product formulation, or the saving by using soy is expressed in relation to the meat substitution level. Today, however, soy suppliers offer a range of products with different properties regarding taste, functionality and price. Therefore, I find that the meat substitution level is inadequate as an indicator of the quality of the end product and the money-saving potential.

The most important question for the consumer is not necessarily how much meat the product contains, but rather how is the relationship between price and quality. In our experience, these two questions are rather independent.

But in this connection, the primary decision maker is the meat processor. Therefore, let us look at the economy from his point of view.

How can we as protein suppliers help him to be successful? The answer lies in the simple equation in Table II stating that total profit is the sales' volume multiplied with the profit per sales unit summarized over all sales items.

TABLE II

Competition Parameters

Annual profit $P = \sum_{i=1}^{N} (p \cdot v)_i$, kr./year

Parameter	Definition	Impact by use of soya proteins
p	Profit per ton, kr./T	Decrease ingredient Cost → increase p
v	Annual sales, T/year	Decrease price → Increase v
N	Number of sales items	New products → Increase N

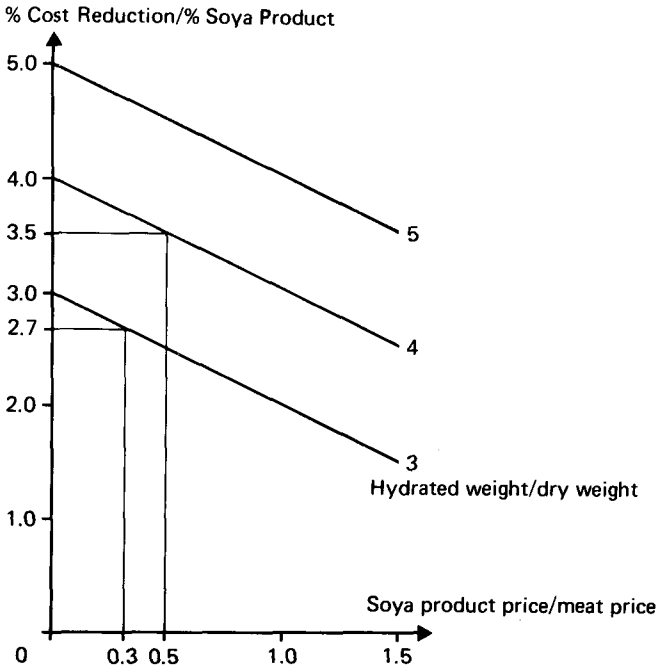

FIG. 1. Cost reduction by meat substitution.

With soya we can influence all three parameters.

Speaking of practical meat recipe development, the starting point is most often an idea of the price-quality level of the finished product. Therefore, the concrete task will often be either to optimize the quality (i.e., try to increase the sales volume) within a fixed cost level or to minimize the ingredient cost (i.e., increase the profit per item or lower the retail price), given a certain quality of the end product.

A comprehensive treatment of the various assumptions is beyond the scope of this paper. I shall limit myself to present some typical cases of soy economics.

Case No. 1: Cost Reduction by Meat Substitution

Our starting point here is the situation where a producer of a "pure meat" product is considering the possibility of introducing an alternative product with soy. He has decided that to be competitive, the ingredient cost of the new product should be 25% below the cost of the "pure meat" product, which is 17 Dkr./kg. The meat producer is considering use of a textured soy flour, which is offered at a price of 5.1 Dkr./kg.

Now you can calculate the dosage of this product corresponding to the desired cost reduction from Fig. 1. The graphs are based on the assumption that the meat prices be unchanged before and after the soy addition, but if you want to keep the fat content on the same level as before soy addition, the real cost reduction is greater than indicated in Figure 1.

It can be seen that by using a normal 1:2 hydration ratio, we obtain a cost reduction of 2.7% of dry soy product added. Thus, the dosage in the said formualtion should be $\frac{25}{2.7}$ % or 9.25% of dry textured soy flour.

Furthermore, Figure 1 can be used to calculate an alternative formulation with another brand of soy protein. Let us assume that our meat producer has also been offered a texturized concentrate at a price of 8.50 Dkr./kg. How should the formulation be to reach the same cost reduction? Figure 1 shows that when using a 1:3 hydration ration the saving is 3.5% per % of dry soy product added. A 25% cost reduction with this product is therefore obtained with a dosage of only 7.15% dry addition.

Table III summarizes the two examples. The exact

TABLE III

Examples of 25% Cost Reduction

	Product A	Product B
Price D.kr./kg	5.10	8.50
hydration ratio	1:2	1.3
	Formulation A	**Formulation B**
Meat	72.25%	71.40%
Soya product	9.25	7.15%
Water	18.50%	21.45%
Cost D.kr./100 kg	1275	1275

TABLE IV

Retail Price Examples
Minced Red Meat

	Chain A	Chain B
Cost without soya proteins, kr./kg	26.00	33.90
Cost with soya proteins, kr./kg	15.00	18.25
(% soya product added)	(8)	(6)
Cost reduction kr./kg	11.00	15.65
(%)	(42)	(46)

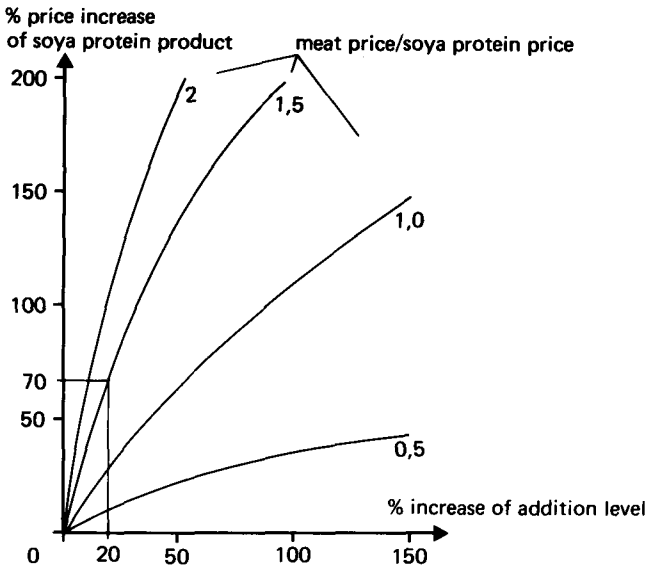

FIG. 2. Price-quality relations for soy protein products.

figures are only meant as an illustration, but the principle is confirmed in practice.

The final decision concerning formulation will, of course, depend not only on economy, but also on other criteria such as sensory and nutritional quality.

So far, I have only referred to savings from the meat processor's point of view. To illustrate that consumer economies can as well benefit from the use of soy proteins, I have in Table IV shown prices for red meat with and without added soy in two Danish supermarket chains. It is seen that the actual retail cost reduction is in fact greater than indicated in Figure 1.

Case No. 2: Economic Comparison of Competing Soy Products

In comparing the economic potential of various soy protein products on the market, it is customary to focus on the price per kilo before or preferably after hydration. From this point of view, a more expensive soy product may be more economic in use if the relative price increase is less than the relative increase in the water-binding capacity. But, as mentioned earlier, there is in general no restrictions on the meat content in Danish meat products for domestic consumption. Therefore, it may be erroneous to base the

TABLE V

ISO-Cost Formulations

	Formulation A		Formulation B	
	%	D.kr./kg	%	D.kr./kg
"Meat"	86.0	7.50	83.2	7.50
Soy product	4.0	5.00[a]	4.8[b]	8.50[c]
Water	10.0	0	12.0	0
		6.65		6.65

[a]"Meat price"/soy product price = 7.50:5.00 = 1.50.
[b]Dosage increase from Figure 2 = 20%.
[c]Relative price increase = 3.50:5.00 = 70%.

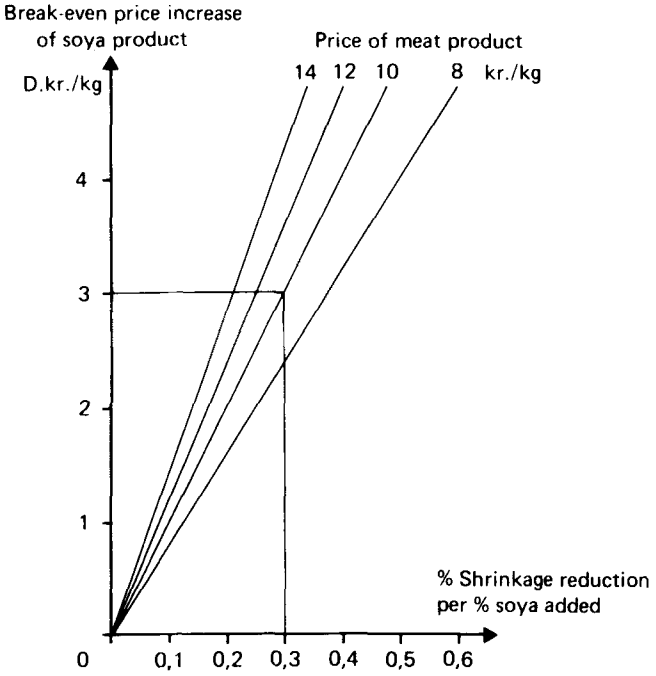

FIG. 3. Shrinkage reduction versus higher price for soy protein product.

comparison on formulations having the same meat content. Instead, I suggest that comparisons should be made on the basis of formulations experimentally found to give the same quality of the end product - as defined by the customer.

In Figure 2 is shown how price and quality of various soy products can be related by simple arithmetic calculations. Graphs are shown for various values of meat/soy price proportions. For reasons of simplicity, the hydration factor is fixed to 2.5 parts of water per part of soy protein. To illustrate the use of the figure, let us consider a case where a meat producer is offered two different soy products. The specifications and the corresponding formulations calculated from Figure 2 are shown in Table V. This means that if we are able to demonstrate that the quality of the end product, using the more expensive brand, B, in a dosage of 120% of the less expensive brand, A, is judged equal to or superior to the quality using product A, then the high priced product B is competitive.

This case demonstrates that when you are free to substitute a greater part of the meat with a high quality soy product, then the higher price for this is easily balanced by the saving in meat expenses, even without assuming a higher water absorption capacity.

Water-binding capacity is especially important in products exposed to shrinkage during processing. From Figure 3 we can calculate how much more a meat processor should be able to pay for a soy product with a higher water absorption capacity. The soy addition level and hydration ratio

TABLE VI

Vienna Sausage with and without Deboned Meat

	Basis %	With deboned meat %
Lean meat	32.0	18.0
Fat	25.0	25.0
Water	31.0	31.0
Other ingredients	8.0	7.0
Deboned meat	---	6.0
Blood plasma	---	
Other ingredients	8.0	7.0
Skimmilk powder	4.0	---
Deboned meat	---	6.0
Blood plasma	---	6.0
Danprotex-B	---	2.0
Danprolact	---	4.0
Danpro-H	---	1.0
Cost kr./100 kg	802.00	632.50
Cost reduction, kr./100 kg	169.50	
Cost reduction %	21	

are assumed constant.

For example, if you consider switching to another soy brand costing 3 Dkr./kg above your present brand, and the end product price is 10 Dkr./kg, the change may be economically justified if you can demonstrate a shrinkage reduction of at least 0.3% per % added soy product.

Case No. 3: Utilization of Animal By-products

Increasing use of mechanical bone separators has in Denmark created a still growing need for recipe modifications in order to surmount the well known problems associated with utilization of deboned meat. We have found that further addition of high grade soy protein products improves the quality of the end product by improving yield and consistency and minimizes the ingredient cost.

In this case we consider an industrial recipe for vienna sausage. The intention is to reduce the ingredient cost by means of deboned meat, blood plasma and soy products.

In Table VI is shown how the said vienna sausage recipe has been modified in order to introduce 6% deboned meat. At the same time, skimmilk powder in the original recipe was replaced by a product based on whey and soy concentrate, DANPROLACT, which improved the economy further.

Perspectives

I would estimate that the Danish Meat Industry as a whole by using soy protein products has reduced the ingredient costs in the magnitude of 100 million Dkr. a year. Even to a rather small meat processor the money-saving potential of using soy products is, therefore, considerable and cannot be neglected due to the high degree of competition both on domestic and export markets.

On the retail market and for catering, however, soy proteins are not yet in common use. There are several reasons

for this. Although the relative cost reduction is even greater in these areas, the absolute amount of saved money is not that impressive for a smaller purchaser.

Further, the housewives and caterers are not familiar with the use of additives in the same way as is the meat processing industry. Therefore, no tradition exists for addition of soy proteins to individually prepared force-meat meals. A change in eating habits is bound to take some time. Nevertheless, with the high quality soy protein products that are available today, I feel confident that in the near future we shall see these markets expand. The actual rate will, of course, depend on the meat prices, which by all accounts are expected to increase substantially in the years to come.

The use of soy proteins in meat products in Denmark has been profitable to all groups in the society. It has helped the meat industry, which to a great extent is owned by the farmers, to remain competitive, and it has offered low budget and good quality meat products to the consumers.