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Poster on:

ENZYMATIC BONE CLEANING AND SCRAP MEAT RECOVERY

by

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INTRODUCTION

As a supplement or an alternative to traditional rendering, enzymatic processes have been developed in Novo's Enzyme Application Pilot Plant whereby the following main products can be made:

- A bland soluble protein hydrolysate suitable as ingredient in food products for human consumption.
- A protein hydrolysate suitable for animal feeding.
- A completely clean bone fraction devoid of meat and fat for gelatine production.

SCRAP MEAT RECOVERY

Process 1

Fresh food grade bones are crushed to a size of approximately 20 mm and defatted by a traditional warm water extraction method.

The cleaned crushed bones and defatted stickwater are mixed in a 1:1 ratio and treated with the neutral Novo protease Neutrase® 0.5 L. The following process parameters are applied:

Enzyme dosage:		2-3 kg Neutrase 0.5 L per ton of wet bones
Temperature	:	58-62 °C
pH	:	unadjusted, neutral
Reaction time:		1 hour

The hydrolysis is performed in a tank equipped with heat mantle and agitator. The protein hydrolysate is recovered by screening and decanter centrifugation. The superflow from the decanter is fractionated further using a solid injection centrifuge. Should the supernatant contain substantial amounts of fat a fat separation may be necessary before the protein hydrolysate is pasteurized and further concentrated in a falling film evaporator.

In order to produce a completely soluble food grade meat protein powder it is advisable to concentrate to around 25% dry matter, then remove particulate material by filtration before spray drying. A flow sheet on the scrap meat recovery process is presented in Fig. 1.

Products

Besides the fat a low fat/low salt protein powder with a bland non bitter taste is produced. The taste is evaluated from a 20% dry substance solution at pH 6.5. The composition of the protein powder is shown in Table 1. The amino acid composition compared to the one of lean beef and collagen is shown in Table 2. Among the essential amino acids, especially the content of methionine and tryptophane will be low (not measured). But it should be stressed that this product is an ingredient rather than sole nutrient. The content of hydroxyproline is on the other hand high compared to meat. This is due to the fact that collageneous sinew material is hydrolyzed during the enzyme treatment.

Table 1 Typical composition of spray dried food grade protein powder

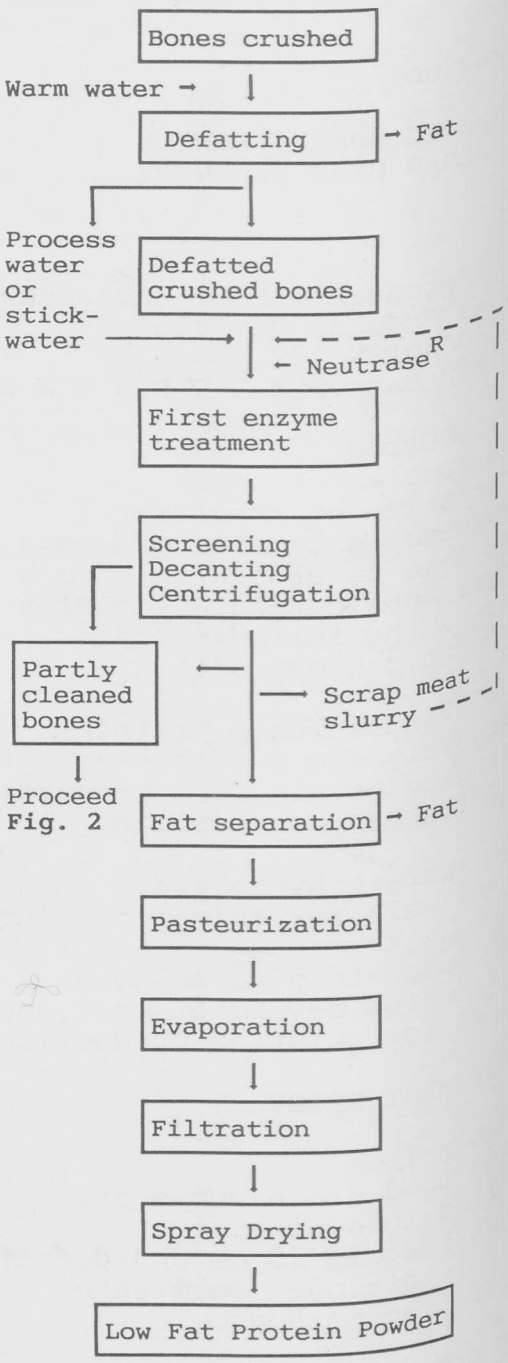
Dry substance (105°C)	96%
Protein (%Nx6.25)	80%
Fat (SOXTEC)	1%
Ash (600°C)	8%
Average peptide chain length (TNBS)	15

Table 2 The composition of essential amino acids and hydroxyproline (g/100 g of protein) in the food grade protein powder compared to lean beef and collagen

	Lean Beef	Protein Powder	Collagen
Isoleucine	4.8	2.5	1.9
Leucine	8.1	5.6	3.5
Lysine	8.9	5.4	4.3
Methionine	2.7	nm*	0.8
Phenyl-alanine	4.4	3.1	2.4
Threonine	4.6	2.8	2.2
Tryptonph.	1.5	nm*	0
Valine	5.0	3.5	2.7
Hydroxy-proline	0	7.4	12.5

* (nm = not measured)

Fig. 1 SCRAP MEAT RECOVERY PROCESS



BONE CLEANING

Process 2
This process can be carried out as the second step of the scrap meat recovery process (as indicated in Fig. 1). But if there is no interest in producing food grade protein powder it is recommended that this process takes the place of step one as well. Then instead of having two enzyme treatments there will be only one. It could be the case if raw material without food grade status was used, or the protein powder is to be used in animal feed.

The crushed and defatted bone material is mixed with process water, e.g. condensate from the evaporator or stickwater, and treated with the alkaline protease Alcalase® 2.4 L. The following process parameters are used.

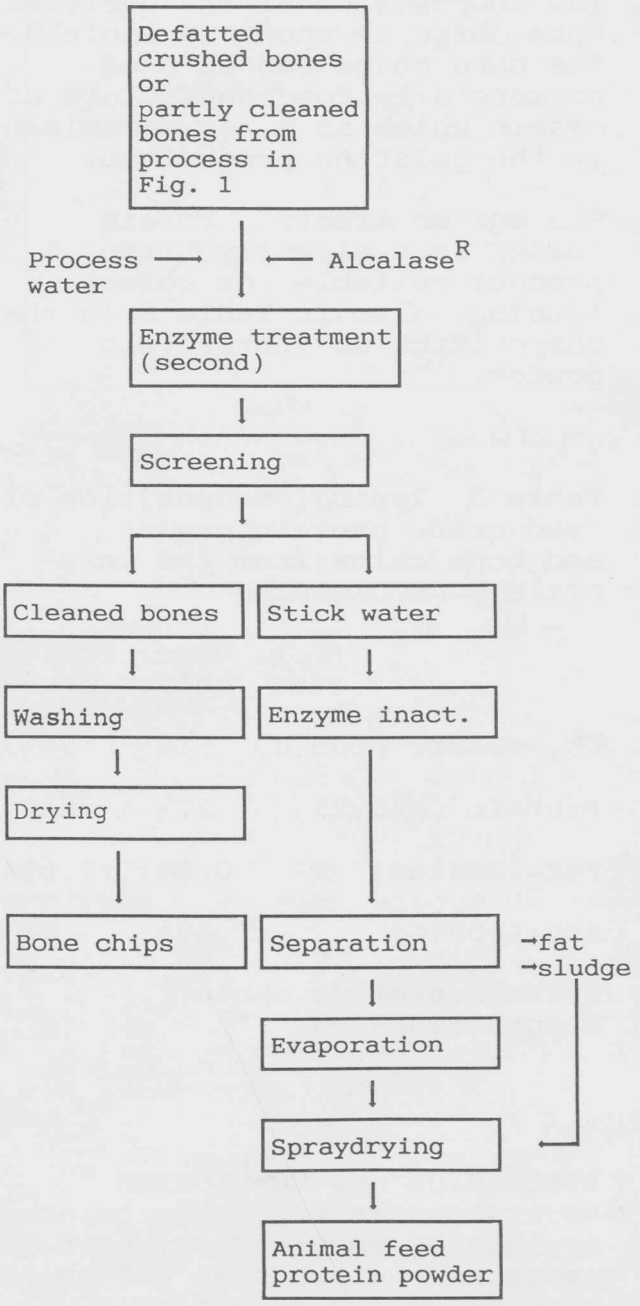
Enzyme dosage : 0.5-1.0 kg Alcalase 2.4 L per ton of wet bones
Temperature : 60-70°C
pH : neutral, unadjusted
Reaction time : 1 hour

This enzymatic treatment secures a complete release of meat and sinew protein from the bones and after the reaction the bones are separated from the meat stick water by screening.

The 1-2 cm bone fraction is washed with 80-90°C hot water and dried under vacuum to approx. 10% water content.

Due to the fact that Alcalase is more heat stable than Neutrase it may be necessary to inactivate the enzyme in the stick water by heating to 85°C for 6 minutes. After separation of residual sludge and fat the stick water is evaporated and spraydried. A flow sheet on the bone cleaning process is presented in Fig. 2.

Fig. 2 BONE CLEANING PROCESS



Products
The composition of the purified bone chips is shown in Table 3. The bone chips can be used commercially for manufacture of ossein which is a raw material in the gelatine production.

The enzyme treated protein powder is a slightly bitter product suitable for animal feeding. Also in Table 3 is the composition of the protein powder.

Table 3 Typical composition of feed grade protein powder and bone chips from the enzymatic bone cleaning

	Bone chips	**Protein powder**
Dry subst. (105°C)	91%	96%
Protein (Nx6.25)	27%	84%
Fat (Soxtec)	0.8%	1.6%
Ash (600°C)	59%	9%
Average peptide chain Length (TNBS)		6

DISCUSSION AND CONCLUSION
As it appears from this paper we are having an alternative of two processes, a two step and an one step enzymatic rendering process.

The chosen process depends on the quality of the raw material and the quality of protein which is in demand.

The two step process is only profitable when the protein can be sold as a food grade product meant for human consumption.

Technically the processes have been designed in a way so that they can easily be carried out in a normal slaughterhouse or rendering plant.

Considering the enzyme Neutrase the chosen temperature, pH, dosage and reaction time ensure a high initial activity of the enzyme and that after one hour the enzyme has been completely inactivated. In that way the degree of hydrolysis is limited to around 5%, ensuring a non-bitter protein hydrolysate.

Conclusively, **NEUTRASE 0.6 L** is recommended for use in a two-step scrap meat recovery process where the products are primarily food grade proteins for human consumption and bone chips gelatine production.

Where **ALCALASE 2.4 L** is used the protein product is most suitable as an animal feed ingredient.

These processes have been developed with the aim of demonstrating a few of the many possibilities which exist when biotechnology is introduced into food technology. Thereby chalenging the industry to obtain inspiration for further developments.

Fig. 1 SCRAP MEAT RECOVERY PROCESS

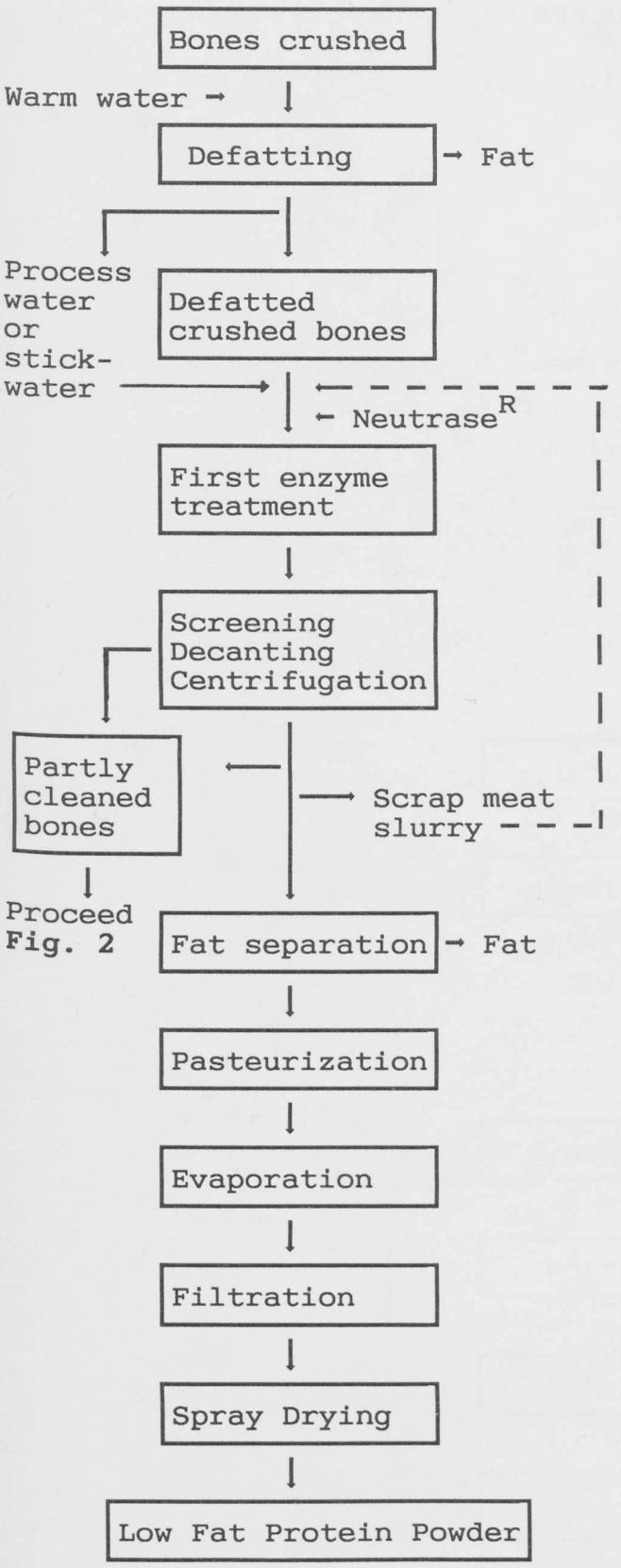


Fig. 2 **BONE CLEANING PROCESS**