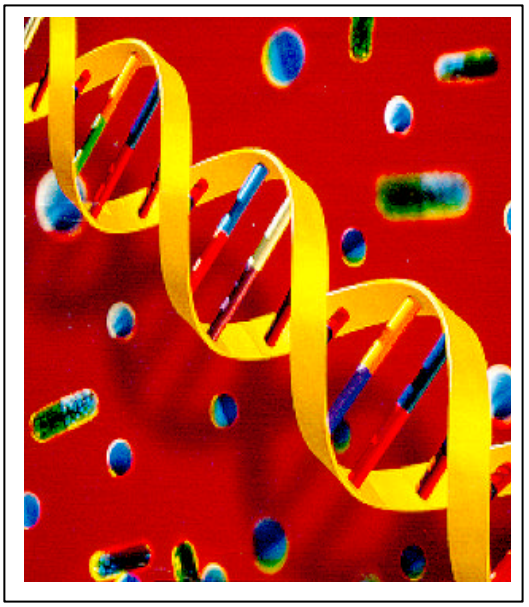
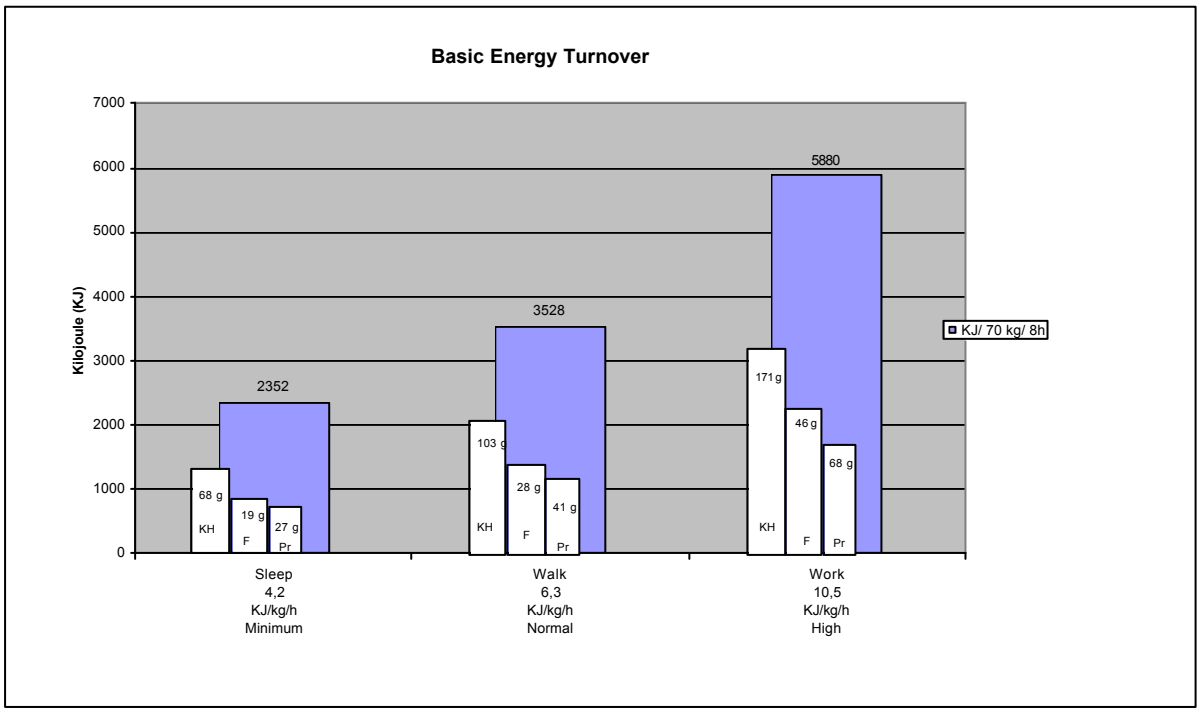
PROTEX - Nã

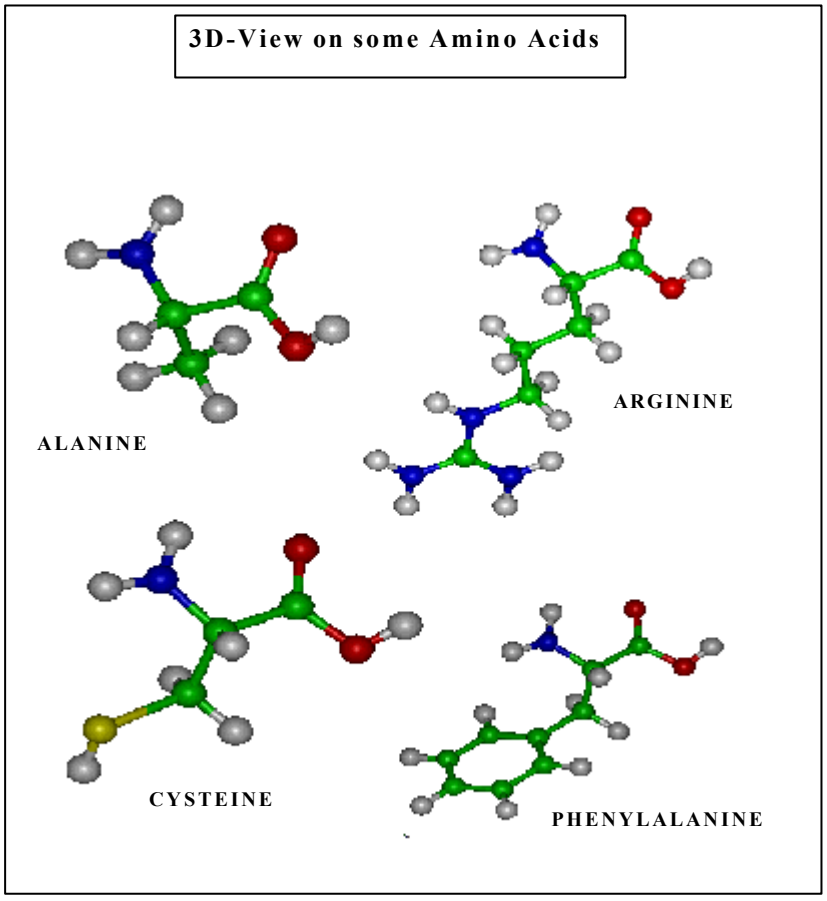


Introduction

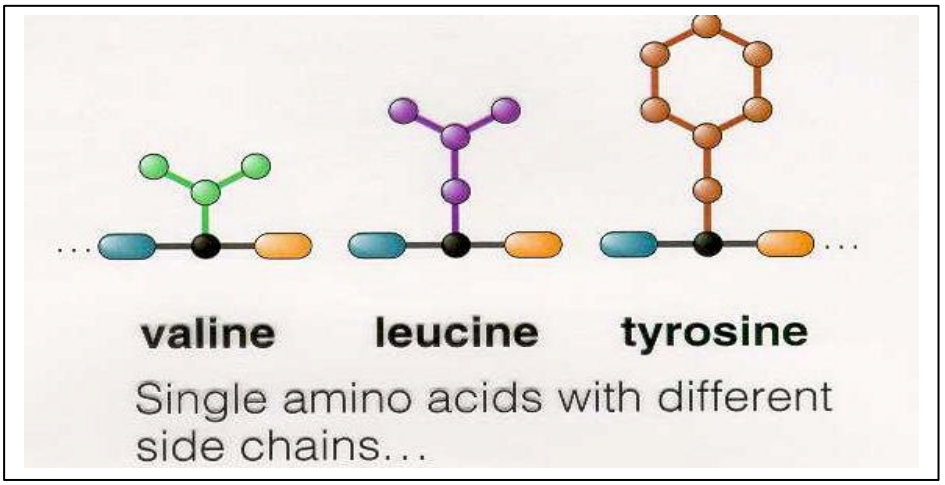
Proteins are polymers of amino acids which structurally form a variety of polypeptide chains which may be water soluble or water insoluble. In comparison to carbohydrates or fat protein can not be stored in the body. Therefore it is necessary to have a daily uptake.

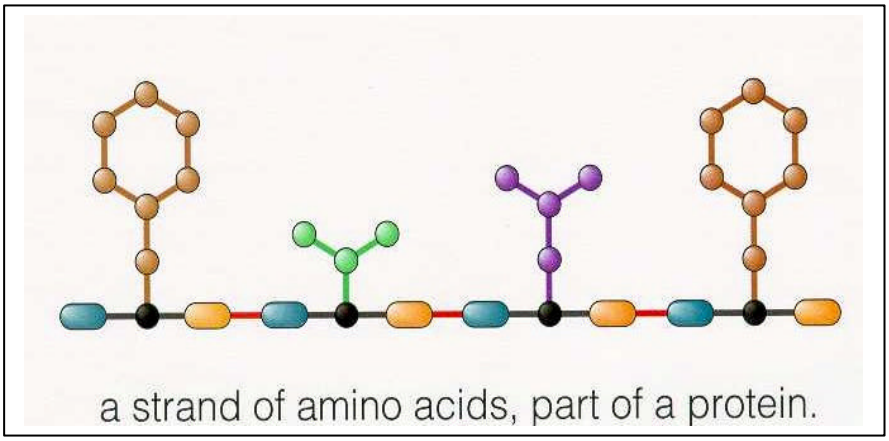


Proteins are comprised of nine essential, six conditionally essential, and eight non essential amino acids.



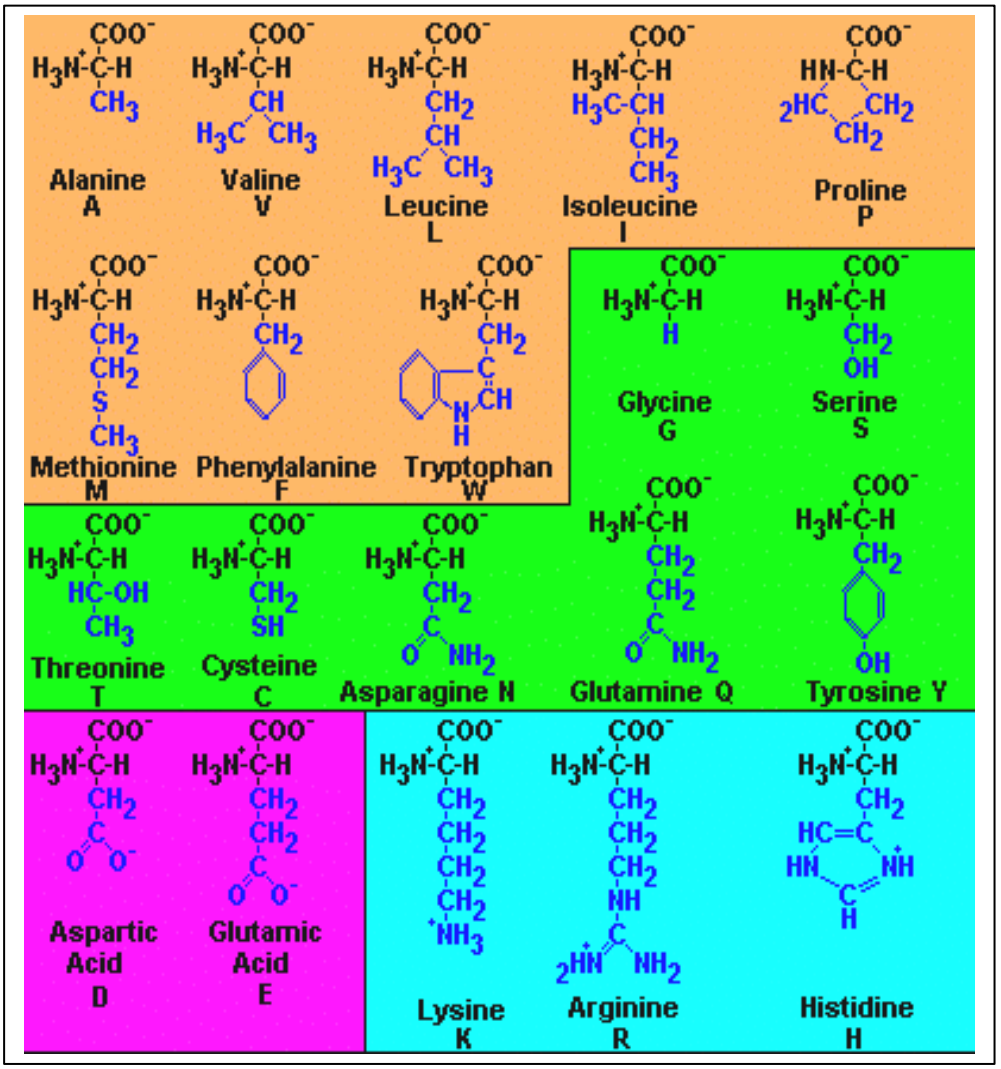
They are extracted mostly from animal and vegetable sources. The difference are the sequence of amino acids.





So wheat protein has an other amino acid sequence than soy or milk protein although the amino acids are the same.

All proteins are build up from 20 different amino acids.



For the quality of a protein it is important to have a high level of essential amino acids. Essential means, that these amino acids can not be build by the body itself.

Essentiell Amino Acids

- Histidine
- Isoleucine
- Leucine
- Lysine
- Methionine/ Cysteine
- Phenylalanine/Tyrosine
- Threonine
- Tryptophan
- Valine

Therefore it is important that these essential amino acids are not destroyed within an extraction process.

To estimate the quality of a food protein The WHO/FAO described a pattern of amino acids, who have to be in a good food protein.

FAO/WHO Pattern for amino acid requirements

Essential Amino Acid	FAO recommendation				Protein Content
	Infant	up to 5	up to 12	adult	in soy isolates
			in mg		in mg
Histidine	26	19	19	16	28
Isoleucine	46	28	28	13	49
Leucine	93	66	44	19	82
Lysine	66	58	44	16	64
Methionine+Cystine	42	25	22	17	26
Phenylalanine+Tyrosine	72	63	22	19	92
Threonine	43	34	28	9	38
Tryptophan	17	11	9	5	14
Valine	55	35	25	13	50

Today it is also necessary to have a good digestibility of the protein product. If the protein denaturation is high, the digestibility of the protein is reduced although all amino acids are in. Food proteins are common that the digestibility is high .

Food Proteins are ingredients for emulsification, gelling, water or fat binding etc. So they are widely used in the industry. Today milk, soy and wheat protein are the major industrial protein components.

Bakery products

Milk Replacer, Bread and Rolls, Cakes and Cake Mixes, Cookies, Crackers, Biscuits Pancakes, Sweet Pastry, Doughnuts, Pasta Products

Breakfast Cereals

Dairy-Type products

Imitation milk, cheese, frozen deserts, coffee whitener, yogurt

Toppings, Infant Formulas

Meat products

Emulsified meat products, Coarsely chopped meats, Poultry Products,

Canned meats like chilli, taco fillings, meatloaf mixes, meatballs, soups, canned minced hams, hot snacks, vegetarian food, pet food

Seafood products

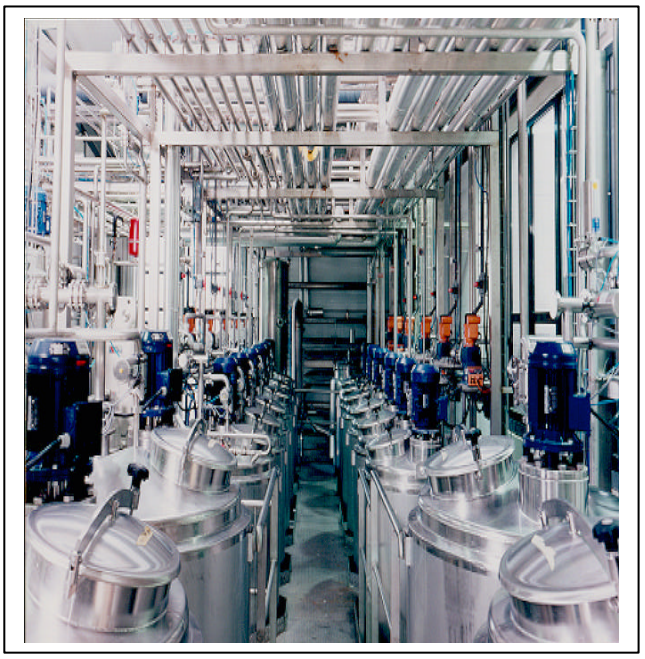
Surimi, formed fish products, fish fingers, fish patties,

The most popular vegetable Protein Ingredient is Soya Protein. It is available as Soya Flour with a protein concentration of 50%, Soya Concentrates with a protein content of 65 % and Soya Protein Isolates with a protein content of higher than 90 %. Ingredient Specialties are Soya Hydrolysates, protein fragments of a whole soy protein. These Hydrolysates are produced enzymatically today.

To satisfy the customer should be the goal of every supplier. However different functionality's make it hard to meet customers interests at all. The traditional process allows the production of one protein quality only. To change the quality means changing the process line very often.

The new international standard in protein processing, the Flottweg Protex-N Process, enables the customers to be highly flexible now. An increased profit return is achieving in comparison to the traditional protein process. Money are saved by reducing operational and investment costs while improving the sensorial quality of the different products (neutral taste). Tailor made products are the state of the art also for small production units.

Protein processing



Historically the isolation of proteins were performed with alkaline and acid. After solubilisation of the proteins at pH 8-9 and centrifugation of the resulting dispersion, the solved proteins were precipitated with acid at their isoelectric point.

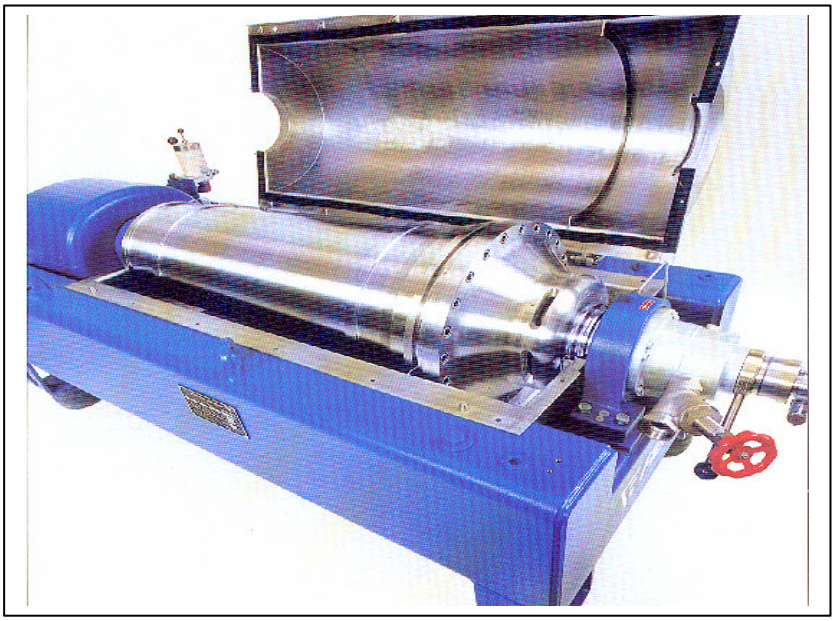
To get out high quality isolates, the extractions were done with raw materials with a high protein solubility (high NSI). This means no or low denaturation are allowed before alkaline extraction. In case of soy so called white flakes were used only.

The following description will give a little overview of the new production technology in comparison to the traditional protein extraction process.

Key elements of the Protex-N process are enzymes and the High Speed Decanter-Technology (HSD) developed by Flottweg. The new equipment specially developed for protein extraction is calling “Prodecanter”.

In comparison to a traditional Decanter the liquid stream is not transported in a counter current process but in the same direction as the bowl is turning. G-forces of 5500 to 6500 are possible without forming foam. All centrifuges using in the process are working identically. The advantage of running the protein

extraction without foaming problems save defoamer, improve the quality of the product regarding taste and allergic reactions and allows a sanitary construction of the centrifuges.



The second key element of the production, the enzymes, enables to increase the solid content of the liquid stream and, this is worldwide the first time, using denatured protein structures (low NSI-value) as a raw material. With the aid of the enzymes, the denatured proteins are opening and forms a structure similar to the native protein before coagulated by acid.

In comparison to the advanced enzymatical protein extraction process of Flottweg proteins with a high NSI-value can be used only. The extracted protein structures of the traditional process using white flakes and the enzyme supported Flottweg process with toasted flakes are comparable. This fact is responsible in getting the same protein quality after protein coagulation by acid. The Protein

curds obtained have the same properties . After washing the curd with water, neutralizing it with sodium hydroxide and drying the protein dispersion by spray drying the isolated protein powders have the same functionality too.

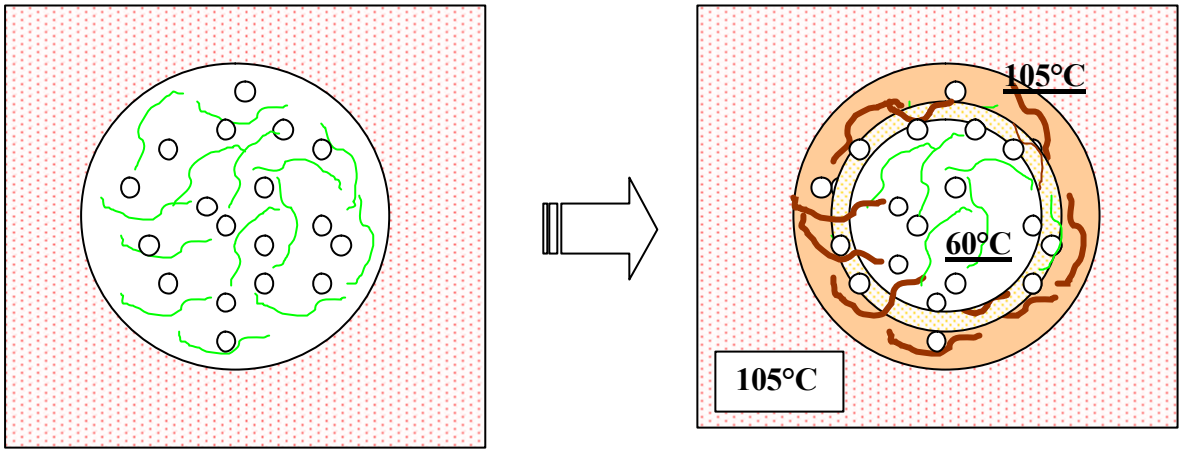
While using enzymes in protein extraction, the functionality of the proteins however can be controlled and set by kind of enzymes and concentration. As long as the remaining protein can be coagulated by acid, as long the Protex-N Process is working. Although enzymes are working in the process, no hydrolysates can be produced on the process line (high solubility, no coagulation possible. Therefore a second module is needed behind the coagulation step to hydrolyse the isolate afterwards.

Enzymes are biocatalysts and are widely distributed in the industry. Food enzymes are of highest purity and are microbiologic origin normally.

In view of pricing of white flakes, the Protex-N Process use normally the cheap hot treated soy flakes. White flakes are dried with vacuum and steam to avoid larger losses in NSI. The difference between the hot treated flake and the white flake are the heat only, which glue the carbohydrate structures together. Although the hot treated flakes are more stronger dried, the digestibility of the soy protein is 95% than 99% in white flakes. However the PDCAAS value is better for concentrates form hot treated flakes than for white flakes. This is documented in the PDCAAS table of the FAO/WHO organization.

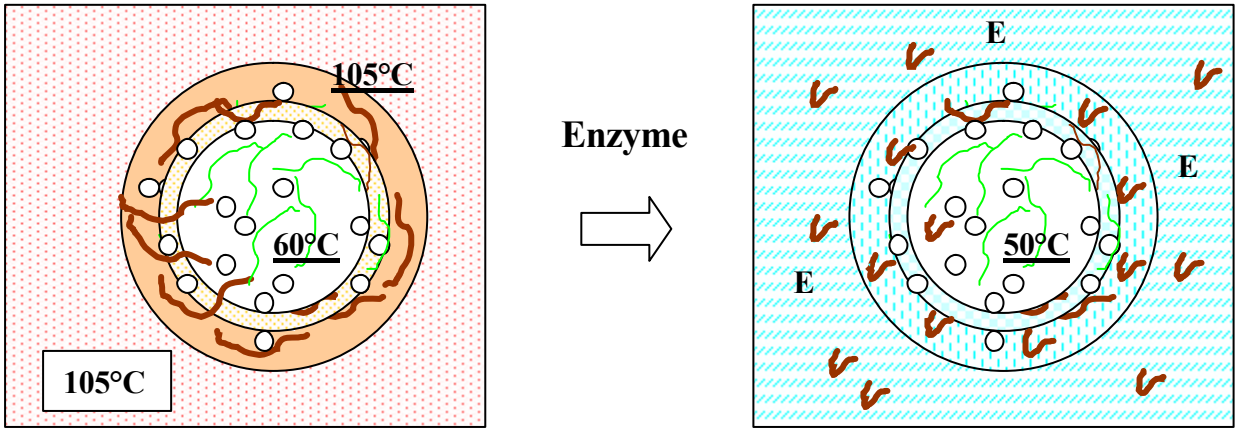
Although the proteins of white flakes and toasted flakes are in quality and digestibility very similar, the extraction yield based on white flakes are better than for roasted flakes. Our understanding for this observation is that the

carbohydrate/fiber structure is burned and bind the protein in a matrix. The higher the heat and the toasting is, the stronger the fiber matrix forms a cage around the proteins.



The result is a low extraction rate for the toasted flakes compared to white flakes. While the traditional extraction process can not destroy the carbohydrate/fiber wall only a low protein extraction take place. Therefore it is not economical to use toasted flakes. In view of this issue the traditional process is to understand.

With the use of special developed enzyme mixtures the Protex-N process have a way of opening the burned fiber/carbohydrate structures in solution and support



the extraction out of the fiber matrix by alkalinity. As a further result of using enzymes for the Isolate production process all liquids a three times more concentrated than for the traditional process with white flakes. This means a reduction in energy, fresh water and waste water and investment in equipment

Comparsion of Process Data

Traditional Process versus Flottweg Process

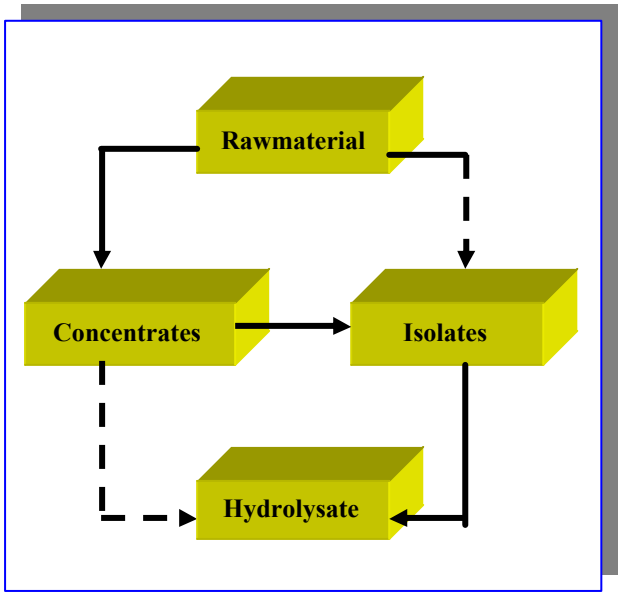
10.000mTo Soy Isolate Plant

	per hour	**per hour**	**per year** (8000 h)	**per year** (8000 h)
Flakes (46% Protein) white / hot treated (to)	3,92	2,92	**31.300**	**23.500**
Liquid stream (1000 l)	112	30	**896.000**	**240.000**
Dry matter (%)	*3,5*	*10*	***3,5***	***10***
- Solid Content (to)	*3,92*	*2,92*	***31.300***	***23.500***
- Protein Content (to)	*1,8*	*1,34*	***14.400***	***10.800***
Fresh water incl. CIP (1000 l)	130	30	**1.040.000**	**240.000**
Process temperature (°C)	50	< 40	**50**	**< 40**
Electrical Energy (kWh)	3000	1500	**24.000.000**	**12.000.000**
Steam incl. Drying (to)	20	14	**160.000**	**112.000**
Waste Water (1000 l)	120	25	**960.000**	**200.000**
- Waste Water Solid Content (to)	*1,43*	*1,25*	***11.500***	***10.000***
- Waste Water Protein Content (to)	*0,48*	*0,18*	***3.840***	***1.440***
Protein Isolate Powder (to)	1,25	1,25	**10.000**	**10.000**
Byprodukt Fiber Powder (to)	1,29	0,5	**10.300**	**4.000**
- Fiber Protein Content (to)	*0,25*	*0,09*	***2.000***	***720***
Yield based on Flakes (%)	33	45	**33**	**45**
- Yield based on Protein (%)	*60*	*80*	***60***	***80***
- Yield Powder based on Protein (%)	*69*	*93*	***69***	***93***

One advantage more is, that the protein losses are lower while washing the flakes to reduce the content of the unwished gas forming short sugars.

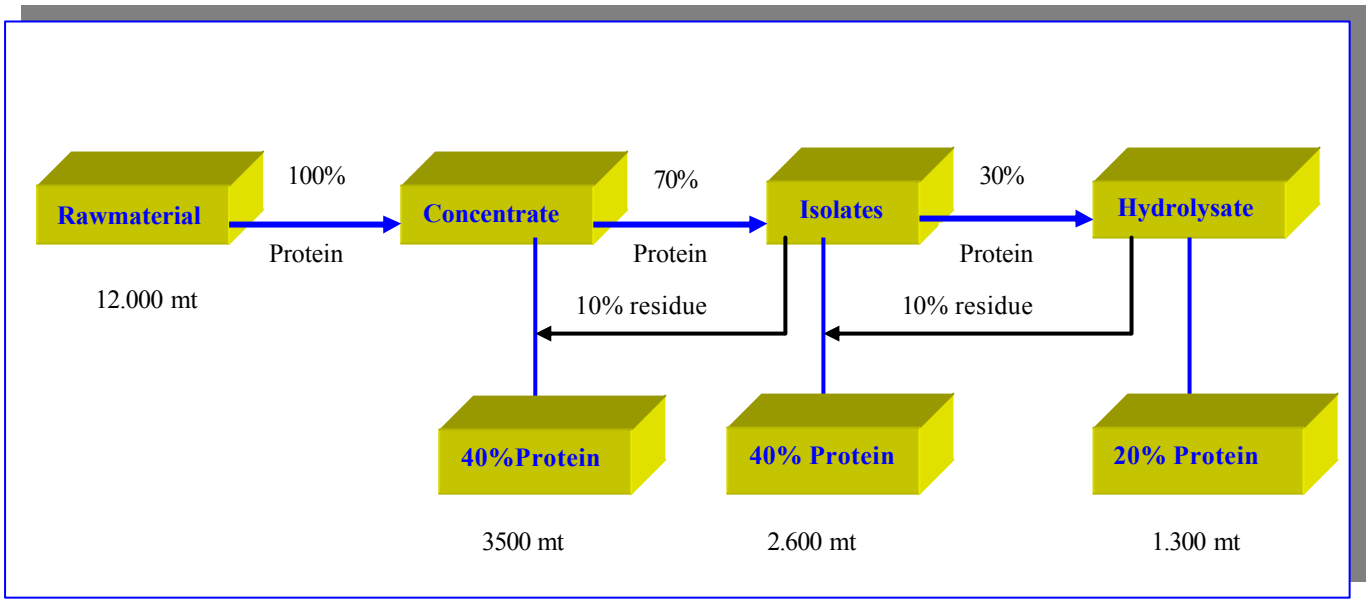
In opposition to all advantages using enzymes to support and improve the protein extraction a disadvantage of the Protex-N Process is the high price of enzymes. Enzymes are still expensive today, but this is a general situation in biotechnology. However they are used as catalyst in such small quantities that the production costs per ton of isolate are acceptable. Therefore the customer have to take in account the whole process technology, the total costs of production and the return based on investment.

The Protex-N Process is a advanced biotechnology process adapted to the high speed decantation technology of Flottweg. This reduce protein losses. As a result of the enzymatical treatment and the high speed decantation the extraction yield is > 80% with the Flottweg Process instead of 65-68 in the Traditional Process based on protein. In the Flottweg technology the customer can choose the protein functionality by using either different enzymes or different enzyme concentrations.



Because the whole process is of a modular design, the plant can be built up starting with concentrates , adding then the isolate module to the first stage and then subsequently being combined with the hydrolysation step.

If increased flexibility of the process is thought, this can be obtained by the parallel production of all products. The following diagram demonstrates an example.



Using different enzymes enables different functional products to be produced without changing the equipment. This is only a question of recipes. The words " customer orientated" fits best.

In case of producing soy isolates 14 m^3 of fresh water are used only for 1 metric ton of toasted flakes. Only 20% of that is water with 50°C.

The use of enzymes enables the processing of the flakes in total. In total means that beside the main product, the soy isolate, valuable byproducts are produced. Flakes have 46% -48% of protein, the rest are fiber, carbohydrates, fat and ash/minerals. After protein extraction the remaining fiber fraction contains 20% of non solubilised protein, which corresponds to 6% -8% of the original protein. This fiber fraction can be used as an highly digestible feed with an improved water binding.

In a good approximation the waste water fraction contains 10 % of the total protein and 80% of the soluble carbohydrates/sugars. Flottweg recommend therefore a waste water treatment specially developed for the Protex-N Process to reduce the COD/BOD from 50.000 mg/l to 100 mg/l by forming biogas and biomass .

The biomass is added as a feed to the fiber fraction and increase the protein content, the biogas is fired to heat the steam boiler. More than 95% of the flake is used.

Therefore this new process generation delivers added value to the customer.

The Protex-N Process is a universal technology. As long as a protein containing raw material is used, as long this process is working. Until now different proteins are produced. In all cases the enzyme recipe is the key to success.

To support the enzymatic action the dispersions have to be in a particle size of 120 µm. This can be done by milling or homogenizing.

The technology is optimized by the developed enzyme mixtures. However the customer is not bounded to use only these mixtures if he will spent money and time for an own enzyme mixture.

The following products have been tested and processed to:

Raw material	concentrate	isolate	hydrolysate
Vegetable products			
Soy	*	*	*
Pea	*	*	
Corn	*	*	
Rape seed	*	*	
Peanut	*		
Cotton	*		
Potato	*	*	*
Tapioka	*		
Lupine	*	*	*
Wheat	*	*	*
Milk products			
Casein	*	*	*
Whey	*	*	*

A new technology has to convince the customer first. Flottweg knows this situation very well. Convinced from the own technology we build an industrial pilot plant as a demonstration plant in our headquarter in Vilsbiburg, Germany. Vilsbiburg is located close to the airport of Munich and enables an excellent connection to the world.

The Process Center is build as a service center to run customer own rawmaterials in a scale of 4 m^3 per hour. This corresponds to a production size of 5000 metric tons of soy flakes. With this investment the customer can be sure to get an working system for his product.

This center is also available as an after sales service to our customers. Here new products can be developed in a scale of 1:1 without stopping a running production. This takes away the risk of an incorrect decision and helps our customers in producing tailor made products.

Therefore Flottweg proudly presents the advanced protein technology of the second millenium the biotechnological supported

Protex-N^{ã} Process.