

Vitana Food Ingredients

Protein hydrolysates in food

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Introduction

The consumption of various additives has been consistently growing since the mid-20th century around the world; one of the key functions of these substances is to improve the sensory quality of some foodstuffs of animal and vegetable origin. These substances include different seasoning preparations, such as protein hydrolysates. In the food-processing industry their production is focused on the preparation of products enhancing the flavour of soups, sauces, salads, meat and vegetable meals and ready-made meals.

Appropriately modified protein hydrolysates are even used in medicine, where they can serve as dietary and infusion components.

Types of protein hydrolysates

Depending on the type of production protein hydrolysates can be divided into two main groups:

1. *Acid hydrolysates: their production was initiated by the Swiss miller Julius Maggi at the end of the 19th century; at present they are extensively produced and researched in Europe; hydrolysis is overwhelmingly conducted using hydrochloric acid;*
2. *Enzyme hydrolysates (origin and main production and research facilities are located in Far East countries; it is produced by fermentation of fish meat – Vietnam, Thailand, soy –Korea, China, soy and wheat mixtures – Japan, or yeast - Europe).*

Production of acid protein hydrolysates

The main raw protein materials used in the Czech Republic for the production of hydrolysates include defatted soy flakes and wheat and corn gluten. Some special hydrolysates are prepared using other materials, but their importance is smaller.

The production process comprises several basic operations: hydrolysis, neutralization, filtration, maturation and partial or complete dehydration, if applicable. Hydrolysis uses hydrochloric acids with a concentration of about 6 mol per litre (about 20%). The conditions during hydrolysis (temperature, pressure, time of hydrolysis) depend on the type of the input material. The temperature usually ranges between 105 and 120°C, with a pressure between 0.15 and 0.20MPa. Under these conditions hydrolysis takes about 8 to 12 hours. The degree of hydrolysis depends on the content of nitrogen in 2-amino acids. Hydrolysis should be finished when this content constitutes 35 – 58% of the total nitrogen content in the hydrolysate. The hydrolysate is neutralized to pH 4.5 – 7.0, most often to pH 5.3 – 5.5, using sodium hydroxide (or bicarbonate). The hydrolysate matures when stored for 1 to 6 months, gaining a finer taste and aroma and a brighter color. At the same time a certain share of sodium chloride and some amino acids with worse solubility (mostly aliphatic, branched) settle down. Neutralization and maturation are followed by hydrolysate filtration. The liquid end product contains 30 – 40% of sodium chloride.

A large portion of production of protein hydrolysates involves dried hydrolysates. At present there are three fundamental drying procedures: spray drying (resulting in hydrolysate in the form of a fine powder), drying in drum driers (hydrolysate powder particles are bigger) and granulating. There is no correlation between the size of hydrolysate powder particles and hydrolysate quality. The quality of the hydrolysate mostly depends on the input materials used and the method and progress of hydrolysis. As compared to traditionally dried hydrolysate, granulated hydrolysate rehydrates faster and more easily. In some cases it is recommended to bleach the hydrolysate before drying. The bleached hydrolysate is more suitable for products made from light meat (e.g. poultry), while

colored hydrolysate is more suitable for darker types of meat (e.g. beef). The following table shows an approximate composition of dried hydrolysates. The variability is caused by the input material and production processes.

Parameters	Value (%)
Dry matter	96 - 98 %
Ashes	43 - 51 %
Organic solids	46 - 55 %
Sodium chloride content	30 - 42 %
Total nitrogen	5.4 - 7.2 %
Amino acid content	34 - 45 %
Glutamic acid content	5 - 17 %
pH	4.8 - 5.4

Diverse extracts (lovage, onion, mushroom, vegetable, some herbs, fruits etc.) or even synthetic aromatic substances are used for flavouring and aromatization of hydrolysates.

Some hydrolysates are also prepared for special purposes by deliberately removing certain components. This usually applies to some components of the aroma of the hydrolysate: sodium chloride, colorants or some amino acids. If such a modified hydrolysate is used, it results in a more varied taste and aroma than in the case of foodstuffs containing the original hydrolysate.

Hydrolysates produced for medical purposes – special nutrition, infusions etc. – constitute a special group. In this case virtually all accompanying components are removed, resulting in a highly pure mixture of free amino acids.

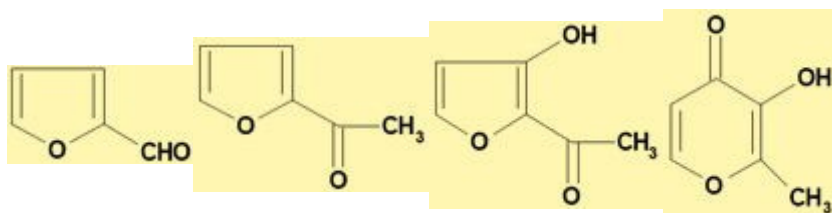
Chemical composition of protein hydrolysates

Protein hydrolysates contain a high number of volatile and non-volatile substances that influence their chemical properties and sensory quality. The most important non-volatile substances are free amino acids and sodium chloride. The content of individual amino acids depends on the input materials and the conditions of hydrolysis. Some amino acids (serine, threonine, histidine, phenylalanine, tyrosine) disintegrate in part or in full (tryptophane) during hydrolysis. Aliphatic branched amino acids (isoleucine, leucine, valine), which are stable during hydrolysis, are not too soluble and are converted into filtration residues after neutralization. The content of these amino acids is therefore lower than suggested by the input material used. In addition, all hydrolysates contain glutamic acids, but also high quantities of asparagine, proline, arginine, alanine and leucine. On the other hand, hydrolysates contain very small quantities of histidine, tyrosine, isoleucine, hydroxyproline and sulphur-containing amino acids and virtually no tryptophane.

Carboxylic acids, created either from amino acids by way of the so-called Strecker's degradation or by degradation of saccharides in an acidic environment, such as levulinic acid, are important carriers of the aroma of protein hydrolysates. The products of dehydration of levulinic acid during hydrolysate drying are α - and β -angelicalactones (Fig. 2), which are typical components of the aroma of the dried product. A basic component of the typical aroma and taste of hydrolysates is 4-ethyl-2-hydroxy 3-methyl-2-buten-4-olide (also called "Maggi lactone" (Fig. 2)), which is created from threonine in an acidic environment. Phenols and heterocyclic furans, pyrones and pyrazines are other important components of the aroma of hydrolysates. Heterocyclic compounds are commonly created as reaction products of non-enzymatic browning. The most important compounds include 2-furaldehyde (furfural), 2-acetylfuran, 3-hydroxy-2-acetylfuran (isomaltol) and 3-hydroxy-2-methyl-4-pyron (maltol), which have a very intense caramel smell and are especially present in dried hydrolysates (Fig. 1). Substituted phenols are created in hydrolysates mostly by degradation of phenol acids. 2,5 – dioxopiperazines (Fig. 2), created from linear dipeptides during

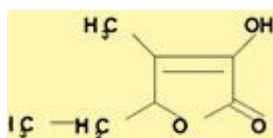
hydrolysis, constitute an important gustative element of protein hydrolysates.

Aglycones of the isoflavonoids genistein, daidzein and glycitein, which occur in soy hydrolysate, cause its antioxidant activity. Isoflavonoids as such are a natural component of soy beans.

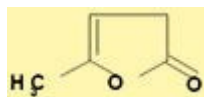


furfural 2-acetylfuran isomaltol maltol

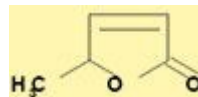
Fig. 1 Important heterocyclic compounds of aromatic hydrolysates



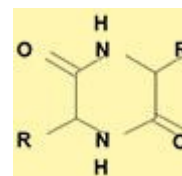
“Maggi lactone”



α -angelicalactone



β -angelicalactone



2,5-dioxopiperazines

Fig. 2 Structure of 2,5-dioxopiperazines and lactones

Conclusion

Protein hydrolysates are used in the food-processing industry as finished products or intermediate products for the production of other derived aromatic substances. Their position on the food market is continuously strengthening, which results in a distinct increase in their importance in human nutrition. This trend is expected to continue in the future.