Yeast extract –

Information for food professionals

Contents

The production of **yeast** extract

The natural ingredient yeast extract is produced in three steps: First sugar is added to the yeast, so it can grow. In the second step, enzymes already enclosed in the yeast split the proteins contained in the yeast into smaller building blocks and ensure that the wall of the yeast cell becomes permeable – this process is called autolysis. Finally the ingredients dissolved out of the yeast cell – the yeast extract – are separated from the surrounding cell wall and dried.

The yeast fungus was already an important part of food culture in earlier advanced civilizations – it was not only used for baking bread but also for making beer and wine. Yeast extract also is made from natural bakers' or brewers' yeast.

In order to obtain the yeast extract, the yeast is fermented first: Sugar is added to nourish the yeast fungus. In addition, a temperature of 30 degrees Celsius and a sufficient supply of oxygen are ensured in large containers, the so-called fermenters. So basically, the conditions are the same like when baking at home, so that the yeast can develop and grow in the best possible way. When the fermenter is full and no more sugar can be added, the yeast is concentrated and washed in centrifuges in order to remove the sugar residues. The result is a so-called suspension, a viscous, creamy yeast mass.

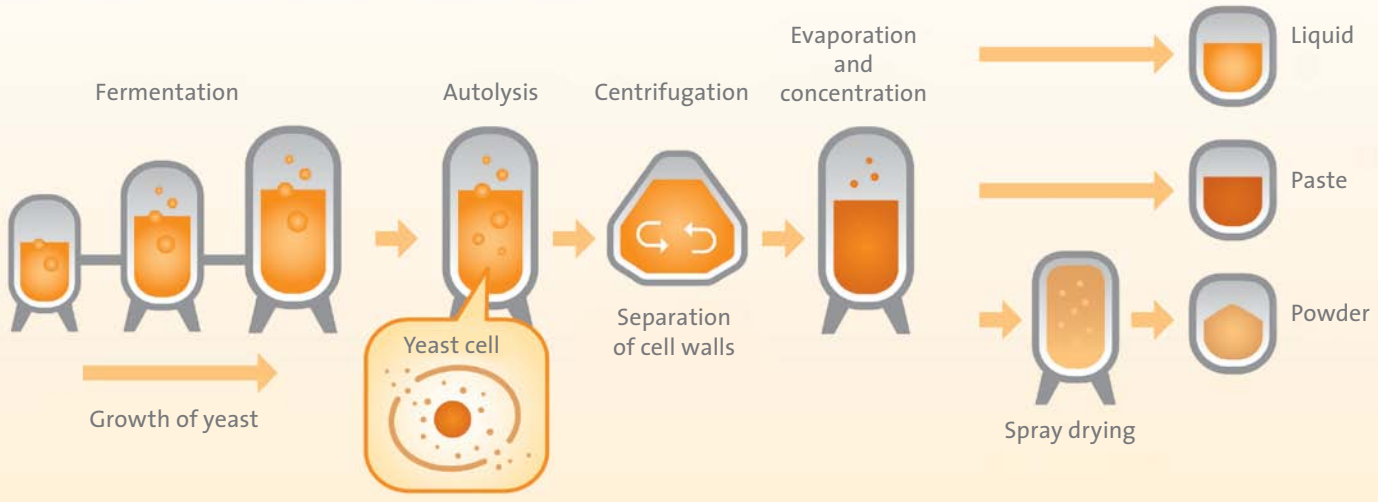
Then a process called autolysis is effected at a temperature of 45-55 degrees Celsius – likewise under controlled conditions in large tanks: The yeast stops growing at approximately 40 degrees Celsius. The enzymes in the yeast or added enzymes break down the contained yeast protein and other macromolecules into smaller molecules. The cell walls of the yeast cells also disintegrate. This means that the smaller molecules can now leave the yeast cell and mix with the aqueous solution in the tank.

This autolysis process can be controlled using a variety of factors. For example, it is the retention time of the yeast in the tanks or the temperature that play an important role and have a significant influence on the future taste of the respective yeast extract. The product resulting from the autolysis process is a liquid that already tastes like a bouillon and, in fact, also has a very similar amino acid profile to a cooked meat stock (Please also cf. "A comparison of amino acid profiles" on page 7).

To become yeast extract, the liquid must now only be centrifuged in order to remove the remaining cell walls. Valuable proteins, vitamins and minerals from the yeast cell remain preserved in the yeast extract. In simple terms, yeast extract contains all the natural components of the yeast cell without the surrounding cell wall.

Finally, the yeast extract is concentrated in a gentle evaporation process under vacuum conditions at around 60 degrees Celsius – to a paste with 70-80 per cent dry weight or to a liquid with 45-65 per cent dry weight. Depending on the future use, the liquid yeast extract is then dried and pulverized: The liquid is fed into a so-called spray tower and dried using hot air. The water evaporates during this process so that the dried extract falls down and collects at the base of the tower.

Production of **yeast** extract



Yeast extract in the food producing industry – a seasoning ingredient

In media coverage there is sometimes the accusation that yeast extract is a kind of "hidden flavour enhancer". But just what function does yeast extract have in food production? EURASYP asked the expert Prof. Dr.-Ing. Achim Stiebing, Head of the Institute for Food Technology.NRW (North-Rhine Westphalia, Germany) at the University of Applied Sciences Ostwestfalen-Lippe, vice-president of the German Agricultural Society (Deutsche Landwirtschafts-Gesellschaft DLG) and member of the board of trustees of the German Consumer Foundation (Stiftung Warentest).

Yeast extract is criticised as an ingredient because it contains the amino acid glutamate. How do you assess the use of yeast extract in food production?
Yeast extract contains the macronutrients proteins and carbohydrates and furthermore the micronutrients vitamins and minerals. The proportion of glutamate is usually low – below five per cent. Yeast extract is a natural ingredient and not an additive. I see many advantages of using yeast extract in food production – also speaking as a consumer – since the taste inherent to savoury products can be balanced with the optimal dose.

Which ingredients introduce natural glutamate into food products?
Glutamate is the sodium salt of glutamic acid. Glutamic acid occurs naturally in numerous foodstuffs – also in unprocessed foods. For example, glutamic acid is contained in meat, fish and milk products, but also in some vegetables. Especially high concentrations can be found in Parmesan cheese and soy sauce that are popular condiments used in the kitchen when preparing meals.

How does natural glutamate basically affect the taste of foods? What effect is achieved?
If glutamate is used as an isolated pure substance, then it is deemed an additive and must be included in the list of ingredients. This enhances the characteristic tastes of dishes. The taste "umami" can be translated as "meaty", "savoury" or "tasty" and is also provided by natural glutamic acid. Umami is now counted among the five recognised basic tastes alongside sweet, sour, salty and bitter. Natural glutamate has a taste-accentuating effect that, by the way, also makes it possible to reduce the salt content in foods without having to accept noticeable sensory impairments.

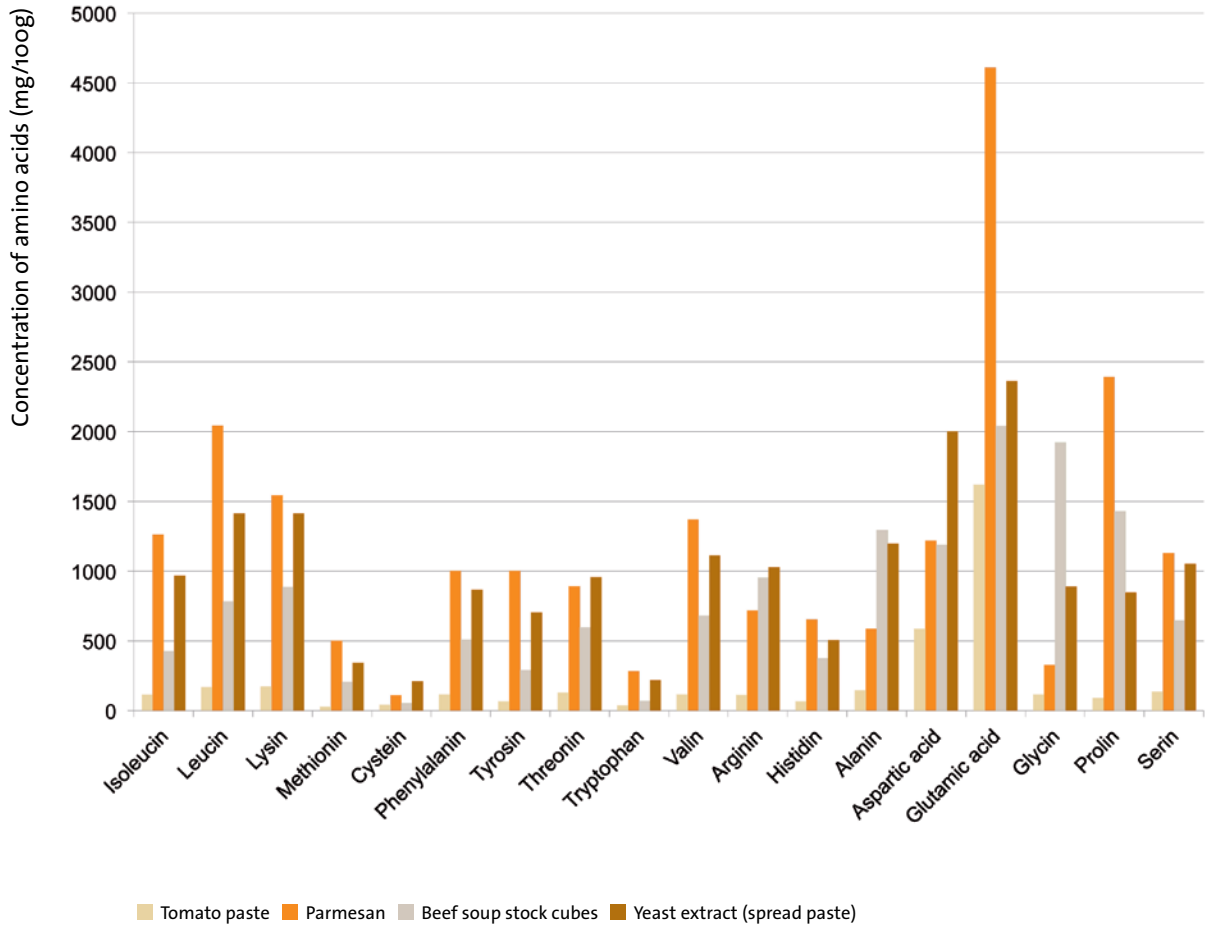
Does the food producing industry aim to achieve a particularly high glutamate percentage when developing recipes and adding ingredients such as yeast extract?
Yeast extract is not used as a tactical move, but as a condiment. The dosages are different depending on the desired effect: The added amounts are very small to round off a taste, whereas, if you wish to achieve a bouillon impression, for example in vegetarian dishes, it will be much higher. However, the myth that glutamate can make up for inferior quality in industrially produced foods is simply false.

A comparison of amino acid profiles

The natural ingredient yeast extract is sometimes criticized because of its natural glutamate content – however, it is a fact that many more foodstuffs apart from yeast extract contain glutamate by nature. The diagram uses the examples of tomato paste, Parmesan cheese, pure beef stock cubes and yeast extract paste to show the presence of different amino acids in the respective foodstuff.

Two facts become very clear: Firstly, the glutamic acid is only one of many other natural amino acids that occur in our food. And secondly, the content of the amino acid glutamate (glutamic acid) in the yeast extract paste is comparable with the content in tomato paste and in a beef stock cube – the clear leader is matured Parmesan cheese.

Amino acids in different foodstuffs



The “umami” taste – essential component of savoury meals

The term “umami” is Japanese and can be approximately translated with “tasty”. It characterizes a savoury note that is sometimes described as meaty. The Japanese scientist Kikunae Ikeda first described the “umami” taste as an independent taste in 1908: He discovered that the human tongue does not only sense – as was assumed for a long time – the tastes sweet, sour, salt and bitter, but also the aromatic “umami” note. Ikeda had observed that the intensive taste of a Japanese fish stock was incomparable to the sense of taste described up till then.

It is above all the glutamic acid that provides the typical “umami” taste. This amino acid occurs in all foodstuffs that are rich in proteins as well as many that have matured – typical examples are meat, cheese and legumes, but also mushrooms or ripe tomatoes.

In the meantime, the existence of further tastes is being researched, such as “greasy”. But still “umami” remains a taste that significantly determines the consumers‘ preferences.

“’Umami’ does not stick out with peaks, but has a harmonising effect and provides depth. This probably makes it the most pleasant taste”, says physicist Prof. Dr. Thomas Vilgis of the Max-Planck-Institute for Polymer Research in Mainz, author of various books on the natural science of cooking and Board member of the German Academy for Culinary Studies.

Dr. Klaus Dürrschmid, Head of the Food Sensory Science Unit at the University of Natural Resources and Life Sciences Vienna, says: “It’s interesting and striking that our taste buds for ‘sweet’ and ‘umami’ are similar – more precisely, 50 percent of their structure is identical. As regards the taste ‘sweet’, it is assumed that there is distinctive innate preference, because babies react positively to it. The same might be true for ‘umami’. This could explain why foods with ‘umami’ taste are so popular.”

Just how important “umami” is for the consumers, is apparent after taking just a short glance at traditional dishes and condiments: Especially well known hereabouts are the various Asian sauces and pastes made from soy, fish or crustaceans. They all inherently contain glutamic acid due to their basic ingredients and have usually gone through fermentation and maturing processes that also contribute to the savoury note. However, you can also find the characteristic “umami” taste in numerous traditional dishes in Western cooking: be it protein-packed meat dishes like goulash, various stocks or also a savoury lasagne that naturally contains a lot of glutamate due to the minced meat, ripe tomatoes and Parmesan cheese used.

Prof. Dr. rer. nat. Ursula Bordewick-Dell of the Department for Nutritional Science at the University of Applied Sciences Munster explains: “The glutamate content of meals provides a savoury taste perception, known as ‘umami’. When foods containing glutamate are consumed this taste is perceived as being particularly delicious and pleasurable – which explains why the above-mentioned glutamate-rich traditional meals remain so popular today. If a lasagne contains a high proportion of meat, especially ripe tomatoes and real Parmesan, it too will have a particularly high glutamate level due to the matured ingredients, which are naturally protein-rich. The savoury taste of meat dishes is increased by natural glutamate when the meat is combined with pulses. A very good example for this: a hearty goulash with peas.”

Yeast extract: natural glutamate

"Glutamate" – is an emotive term for many consumers but also for some nutritionists. However, the fact is: As a rule, no difference is made between the flavour enhancer monosodium glutamate and the natural amino acid glutamate, which occurs in all protein-rich and many ripe food stuffs. Glutamate is also an inherent part of our daily diet – and is metabolized by the body irrespective of its phenotype as an amino acid.

However, there are some important differences between ingredients that are naturally rich in glutamate such as yeast extract and the flavour enhancer monosodium glutamate: Because yeast extract and other natural foods that contain glutamate also have an intensive characteristic taste and are therefore readily used as condiments in many traditional dishes (please also cf. "The 'umami' taste – essential component of savoury meals" on page 8). Many foods that are part of a varied and balanced diet have high glutamate contents and guarantee the aromatic taste of numerous recipes.

"Glutamate is a completely natural building block of proteins", explains Prof. Dr. rer. nat. Ursula Bordewick-Dell of the University of Applied Sciences Munster. "So it by no means only occurs in heavily processed foods, it is found in all protein-rich food sources – for instance in meat, fish and even in pulses. Moreover, glutamate is formed naturally through the enzymatic ripening process in foodstuffs and sometimes in appreciable amounts, for instance in tomatoes and Parmesan. Glutamate is therefore a key component in our daily diet – however, many consumers are unaware that it occurs naturally."

What makes yeast extract – added to meals like a spice to round off the taste – that little bit more special: It still contains the micronutrients vitamins and minerals of the yeast cell. Moreover, apart from the amino acid glutamate it also contains further protein fragments that also contribute to rounding off the taste. In contrast, monosodium glutamate is an isolated pure substance and according to food law ranks among the flavour enhancers and additives. The glutamate is present as glutamate salt, in other words the pure salt of the glutamic acid.

What unites the foodstuffs mentioned and yeast extract with monosodium glutamate is: The contained component glutamate is always metabolized in the same way as an amino acid by the human body.

Labelling

Yeast extract is listed as "yeast extract" – sometimes also as "natural flavour" – in the ingredients list of a product. This complies with the requirements of the European Food Law.

Flavour enhancers like for instance monosodium glutamate have to be labelled as such in the ingredients list of a product: as "flavour enhancer monosodium glutamate" or "flavour enhancer E 621". The E-number means that this is an additive that has been classified as safe and hence been approved in the European Union.

Free and bound glutamate – what is behind all this?

Glutamate occurs in foodstuffs in two different forms. On the one hand, it occurs in the so-called bound form. Here the glutamic acid is linked with other amino acids and so is therefore bound in proteins. In this form the glutamate has only very little taste. On the other hand, it occurs in the so-called free form in plant and animal tissues – this version is the one that makes the taste seem especially aromatic.

Foodstuffs with a high proportion of glutamate such as cheese and ripe tomatoes enjoy a high consumer acceptance because of their intensive tastes. The proportion of free glutamate in plant or animal foodstuffs increases during cooking, fermentation or ripening processes. So it is not surprising that such preparation or refining practices are firmly established in many food cultures – examples for this range from the traditional fermentation of soy sauce over the cooking of a meat stock to the maturing of a Spanish Serrano ham.

The expert Prof. Dr. Thomas Vilgis of the Max-Planck-Institute for Polymer Research in Mainz puts it more strongly and says: “If you were to analyse the content of free glutamic acid in reduced stocks, broth, ‘glace’ and sauces, your result would be: They are all-natural glutamic acid bombs!”

The following examples demonstrate just how many foodstuffs and dishes contain a relatively high proportion of free glutamate. This data was collected in the framework of the working group “Analysis of the natural glutamate content in foodstuffs” headed by Prof. Dr. rer. nat. Ursula Bordewick-Dell at the University of Applied Sciences Munster:

One portion of potatoes (250 g) contains 138 mg and one portion of peas (135 g) 148 mg free glutamate. One portion of beef goulash has 135 mg, one portion spaghetti Bolognese with Parmesan cheese even 1,500-2,000 mg free glutamate. Here the particularly high content is due to the Parmesan, since a 25 g serving of this aromatic cheese already contains about 1,500 mg free glutamate – which would explain why it is so readily used in Italian cooking to give numerous dishes that special aromatic taste.

What free and bound glutamate share is the following feature: They are both digested by the human body as amino acids. That is why there is no reason to avoid savoury foods that contain free glutamate.

How is **yeast** extract used in food production?

Yeast extract is a very versatile ingredient that is used in soups, sauces and ready-meals, but also for snacks and meat products. For food producers, the ingredient is attractive because it distinguishes itself by its savoury taste of its own that provides the typical “umami” or meaty taste. This is due to the amino acid glutamate that naturally occurs in all protein-rich foodstuffs.

The amount of it that is used as well as the purpose that it serves for the recipe as a whole can be best compared to that of a seasoning: Thanks to the savoury taste the products are refined and the overall taste is balanced. However, the average yeast extract content of the end products is low.

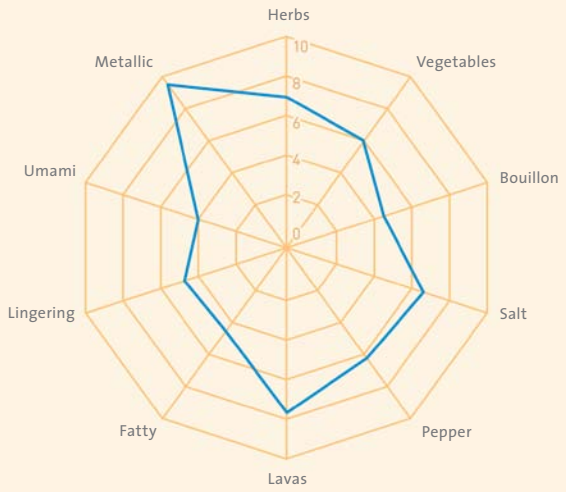
A cooked meat broth has an amino acid profile (Please also cf. “A comparison of amino acid profiles” on page 7) that is very similar to the one of yeast extract. It also has a very similar bouillon taste. For this reason, yeast extract is often used for vegetarian products, for example vegetarian spreads, to give them the typical hearty “umami” taste. Yeast extract is also often used for products with low salt content, because adding yeast extract contributes to providing depth to the taste of low-salt products that are hence better accepted by the consumer.

Sometimes media reports suggest that by adding the ingredient yeast extract, the food industry tries to achieve the highest possible glutamate content and tries to cover the taste of other allegedly low-quality ingredients. However, this is incorrect, because firstly a very high glutamate content is quickly perceived as unpleasant by our taste buds. And secondly, compared to many other ingredients or additives that are used to round off the taste of products, yeast extract is actually considered a pricey ingredient by the food industry.

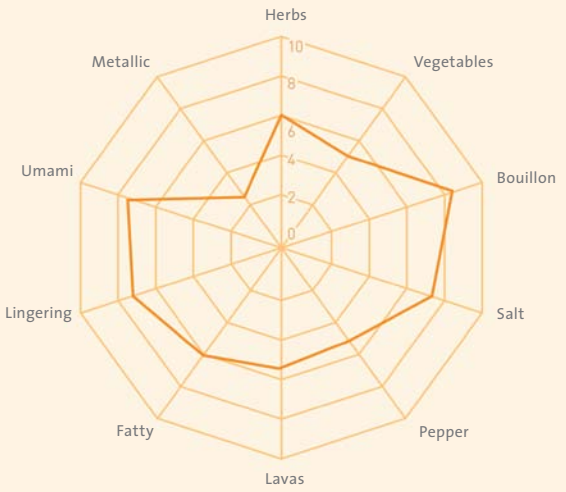
For the success of a food product, it is the harmonious interaction of all ingredients that is of vital importance – which is why the producers spend a lot of time and resources in the development of new recipes. “The dosage is – as always – crucial: A too salty soup is no pleasure, and with too much glutamate, food will taste salty or soapy”, straightens out Prof. Dr. Thomas Vilgis of the Max-Planck-Institute for Polymer Research.

The following illustrations show the effects of yeast extract. The example of a vegetable bouillon and a meat bouillon – with and without yeast extract – illustrates how the natural ingredient balances the different tastes and brings out notes that are perceived as pleasant.

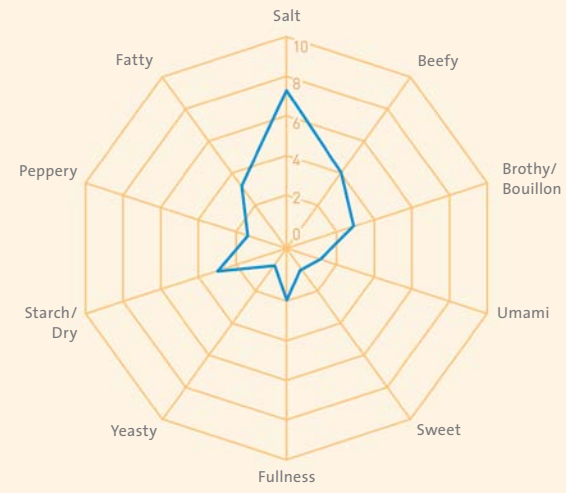
Vegetable bouillon without yeast extract



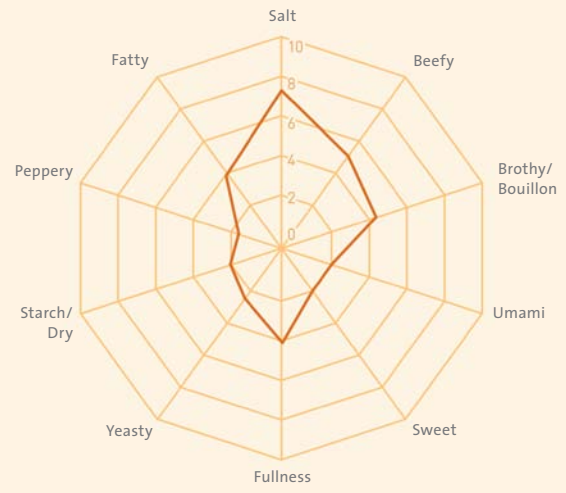
Vegetable bouillon with yeast extract



Beef bouillon without yeast extract



Beef bouillon with yeast extract



Safety of glutamate and **yeast** extract

The media coverage of the past months often mentioned the key word "glutamate" in connection with alleged intolerance reactions, such as the so-called Chinese restaurant syndrome. Occasionally, there was also already talk of the possible risks in connection with neurodegenerative conditions.

Glutamate is, however, not harmful to health. We eat it every day in the form of the amino acid in numerous foods. And it is also true for the additive monosodium glutamate, where glutamate occurs as an isolated pure substance: There are no risks connected to its consumption. "From a scientific point of view, the discussion about natural or artificial is simply misleading. To assess the function of an ingredient during cooking and its effect in the human body it is completely insignificant how it is produced when its molecules are identical", says expert Prof. Dr. Thomas Vilgis of the Max-Planck-Institute for Polymer Research.

Over the last decades, the additive glutamate was tested again and again for its health safety and harmlessness – not least because the rumours on intolerances and other negative effects persisted. "As often, the public opinion on this issue contradicts the scientific point of view", says Dr. Klaus Dürrschmid, Head of the Food Sensory Science Unit at the University of Natural Resources and Life Sciences Vienna.

- In 1987 the Joint FAO/WHO Expert Committee on Food Additives (Joint FAO/WHO Expert Committee on Food Additives, abbr. JECFA) addressed the issue of monosodium glutamate as an additive and analysed the available data on intake, distribution in the body and the excretion of glutamate as well as toxicological data and human studies.

The conclusion of the JECFA was: No negative effects what so ever are to be expected from consumption of glutamate in the amounts usual for foodstuffs. For this reason, the committee decided against defining a so-called ADI value. The ADI value (Acceptable Daily Intake), defines the dose that can be ingested on a daily basis over the course of a lifetime without any appreciable health risk.

- In 1991 the Scientific Committee for Food (SCF)[1] of the then European Community performed a similarly comprehensive safety analysis for monosodium glutamate, and reached the conclusion, as the JECFA had previously, that no ADI was required. This classification is still valid today in the European Union.

- In 1995 the US-American Food and Drug Administration (FDA) commissioned the Federation of American Societies for Experimental Biology (FASEB)[2] with a further safety assessment. The focus was on the question whether the consumption of monosodium glutamate could have a negative effect on brain functions. The result: According to the FASEB there is no proof that consumed monosodium glutamate causes or aggravates damage to the brain cells. Solely in studies where animals received very high amounts of monosodium glutamate directly as an infusion or injection were there any neurotoxic effects. Since the monosodium glutamate in these cases was not ingested by the animals, the amino acid could also not be metabolized in the digestive tract. The FDA assessed the result of the new test as a confirmation of the already existing assessments by the JECTA and the SCF that had rated monosodium glutamate as safe.

1 The SCF is the forerunner organization of the European Food Safety Authority that assesses all risks in connection with the food chain as a European agency today.
2 The FASEB is the leading, independent umbrella organization of scientific expert associations in medical and biological fields in the USA.

In 2007 the Hohenheimer Konsensus Konferenz[3] also examined the topic glutamate. In particular, the effects on the central nervous system and the lung were investigated as well as the question whether there was proof for the so-called Chinese restaurant syndrome.

Based on the studies analysed the conference achieved the following consensus:

- The consumption of glutamate has no negative effect on the lungs. There is no evidence that asthma can be triggered by glutamate.
- No clear description exists for a special sensitivity to glutamate that is expressed with symptoms such as headaches, a stiff neck or numbness – a multicenter study with a placebo did not verify such effects of consuming monosodium glutamate.
- There is no risk that glutamate can pass an intact blood-brain-barrier and cause damage to the central nervous system. A healthy human being has adequate capacity in the digestive system to metabolize the amino acid glutamate, so that the consumption of foodstuffs that naturally have high glutamate content or of meals with added monosodium glutamate does not represent a hazard to health.

3 The Hohenheimer Konsensus-Konferenz [consensus conferences] are independent experts meetings that have been held regularly since 1996 by the University of Hohenheim. Each conference is a meeting of five to eight experts from all over the world that come from different professional fields. Financed by the World Health Organization WHO, the Department of Health, national or international corporations as well as the industry. However, that these organizations could influence the outcome of the conference is ruled out.

About EURASYP

EURASYP is the abbreviation for the European Association for Specialty Yeast Products, which represents the political and economic interests of its members. One of the association's main goals is to disseminate information to the public, so as to strengthen the awareness of specialty yeast products – including yeast extract – as an ingredient in a wide variety of products and dishes.

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