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Brief Review on Fermentation Process and Food Additives

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ABSTRACT

People's interest in healthy eating and quality food is growing these days. There are various sources through which we learn about the advantages and disadvantages of foods, their benefits and some of their harmful effects on humans. Since school, young people are excited and discuss topics related to the composition of food and the role of its components - fats, carbohydrates and proteins. Their structure and properties are studied in the subject Chemistry and environmental protection in the profiled classes. The obtained theoretical knowledge is a basis on which young people form a culture of nutrition, striving to be healthy and energetic. More and more of them choose to continue their studies in specialties related to nutrition. The aim of the present study is to present knowledge from the field of Food Chemistry that is useful for human health. Food chemistry is an evolving discipline studying the chemical processes and interactions of all biological and non-biological components in foods. Foods are a complex combination of chemicals, many of which are vital to our survival. An important part of food content are food additives such as emulsifiers, food colourings, flavourings and preservatives, the main characteristics of which will be presented in the article. Examples of food additives and sweeteners that are harmful to human health are also given. The experimental part of the article describes fermentation as a chemical technology, as well as the importance of alcoholic, acetic acid and lactic fermentations. As an expected result, information about chemical technologies and food additives in food will enrich the knowledge of adolescents on the one hand, and on the

other hand, will be beneficial for their proper development and good health. In addition, students can focus on studying food chemistry and realize themselves professionally in this field.

Keywords: fermentation, food additives.

INTRODUCTION

Food chemistry is a discipline that is interesting to people, especially adolescents, and important to their health. Despite the hectic lifestyle, more and more attention is paid to healthy eating, to the content and quality of food. Young people are looking for information about the products they consume, the harms and benefits associated

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with their use, because quality food is the basis of building healthy, strong and energetic organisms.

Food has always been important for the existence of people throughout the various stages of human development. Several food myths have even formed. The first myth is the claim that there can be food without chemistry. It turns out that there cannot be one, a separate question is whether the chemicals in food products are from nature or are synthesized by man. The second myth is that everything natural is good and artificial is harmful. The truth is that the natural differs only in that it occurs in nature. The aroma and taste of roasted and fried meat is the result of the chemical interaction of substances that exist in raw meat when they are heated. The third myth is that if something does not exist in nature, it is artificial, such as cheese. But man learned to prepare this product a long time ago, and the goal is not to improve the taste at all, but to preserve the chemical substances in milk.

Foods are a complex combination of chemicals, many of which are vital to our survival. Some of the foods help prevent various diseases of the body, and others could be a prerequisite for the development of certain diseases.

Food chemistry is a field that studies how products change under certain processing techniques and ways to improve their quality. It studies the chemical processes and interactions of all biological and non-biological components in food. The most important ingredient in food is undoubtedly water. Other main components are three groups of organic substances: carbohydrates, fats and proteins, like those in biochemistry. Next in importance are vitamins, minerals and enzymes. The information below is intended to represent the characteristics of other food additives such as emulsifiers, food colours, flavourings and preservatives. Food additives and sweeteners that pose a risk to human health are also indicated. An important place is occupied by the described processes of fermentation as a type of chemical technology.

EXPERIMENTAL

The research and analysis methods are used in this article to present some applications of the chemical technologies in the food industry. Different aspects of several applications with describing of specific features of the processes are described.

RESULTS AND DISCUSSION

Fermentation as a chemical technology

Alcoholic fermentation is a complex microbiological and biochemical process controlled by a complex of enzymes. During this process, sugar is converted into alcohol and carbon dioxide, with the additional formation of glycerine, succinic acid, acetic acid and other products in minimal amounts.

The process of alcoholic fermentation in the production of wine goes through two stages. Violent fermentation, lasting 5 - 6 days, is characterized by an intense release of carbon dioxide, creating the impression of boiling the liquid. Quiet fermentation, lasting about 2 - 3 weeks, completes the process, further breaking down the residual sugars.

Winemaking process - after the grapes have ripened, they are placed in a vessel (fermenter), crushed and a mixture of grape skin, grape juice and berries is obtained. Yeast is then added, and this liquid is left for several days, as during this time the yeast interacts with the sugar and alcohol and carbon dioxide are released dioxide - alcoholic fermentation takes place. The resulting liquid goes through a maceration process, where the skins of the grapes are soaked to extract their colour. The wine is drained and placed in barrels and then aged for several years. Then it is filtered, bottled and ready for consumption.

Acetic acid fermentation - the oldest method of obtaining acetic acid is through acetic acid fermentation. Under the action of specific acetic acid bacteria, the oxidation of alcoholic

beverages such as wine and beer take place. The fermentation process takes place at a temperature of 25 - 30°C, and the mass fraction of alcohol in the mixture should not exceed 10 %, otherwise the acetic acid bacteria die. Wine vinegar is obtained by fermentation of wine [1].

The fermentation of fresh milk with the bacteria Streptococcus thermophilus and Lactobacillus bulgaricus is used to produce Bulgarian yogurt and gives it the unique taste that our country is known for. Scientific studies show that yogurt has a positive effect in the treatment of Parkinson's disease due to D - lactic acid [1].

Nutritional supplements

Food additives are substances added to food to preserve or improve taste, appearance or other sensory qualities. They can be divided into groups. Many supplements are created synthetically. The production process includes chemical research aimed at isolating the main ingredients of the specific flavour from natural products. Some of them are emulsifiers, food colourings, flavourings and preservatives.

Emulsifiers

An emulsifier is a substance that stabilizes an emulsion by reducing tension at the oil-water boundary. Emulsifiers are part of a wider group of compounds known as surfactants. Surfactants are compounds that are usually amphiphilic, meaning they have a polar and a non-polar part. Emulsifiers that are more soluble in water will generally form oil-in-water emulsions, while emulsifiers that are more soluble in oil will form water-in-oil emulsions. Examples of food emulsifiers are soy lecithin, sodium phosphates, monoglycerides, diglycerides.

Colorants

Most colorants are used to increase the attractiveness of food products. For food colouring, the dyes from E100 to E180 can be used. Sometimes, however, colorants can perform another role in addition to colouring. For example, sodium nitrite is a substance that binds to meat pigments, not only stabilizes the colour, but is also a good stabilizer through its antimicrobial effect. Colour is the first quality by which a product is evaluated, and it is closely related to aroma and taste. Colorants can be classified according to three characteristics: by colour, by chemical nature and by origin.

Food colorants

A food colorant is any dye, pigment or substance that imparts colour when added to a food or drink. Food colouring is used in both commercial food production and home cooking. Some natural colours: carotenoids (E160, E161, E164), chlorophyllin (E140, E141), anthocyanins (E163) and betanin (E162)

Examples for artificial colorants are red lead (Pb304) and vermilion (Hg5) were routinely used to colour cheese and confectionery. In addition, Copper arsenate ($CuHAsO_3$) also has been used to recolour tea leaves for resale.

Flavourings

Food flavourings (Fig. 1) are used to enhance the sensory experience of food and the ingredients from which it is made.

There are different types of flavourings - natural, identical to natural and artificial flavourings, flavourings of vegetable or animal origin, as well as smoking flavourings. Flavourings are added to products to change the flavour profile of the base ingredients, impart flavour to bland materials, hide off-flavours and aromas, enhance flavour/ aroma after cooking. Proponents of synthetic fragrances argue that they are often stable and less susceptible to temperature and other changes. Opponents of their use, however, argue that they can have negative effects on health.

Often these flavourings have other properties such as adding colour, texture, preservatives or

Fig. 1. Foods with flavourings [2].

Fig. 2. Foods with preservatives [3 - 5].

antimicrobial properties that improve health. Many fragrances are derived from plants, with the fragrance coming from their essential oils, which can be extracted today. Some research suggests that many natural flavourings can add beneficial antioxidants to food and have an important role in human health.

Types of preservatives

Three main groups of preservatives are known - antimicrobial, antioxidant and preventing the browning of products. Antimicrobials (E200 - E290) are used to slow down or stop the development of microorganisms in food. Their purpose is first to prevent the auto-oxidation process, and then to prevent rancidity. Anti-browning agents are chemicals intended to prevent the development of enzymatic and non-enzymatic browning in food products, especially dried fruits and vegetables. Vitamin C (E300), citric acid (E33O) and sodium sulfite (E221) are most often used for this purpose.

Chemical preservatives

The use of chemical preservatives (Fig. 2) in the food industry is widespread and significantly affects food products.

Regulated by standardized rules, each adder receives a unique identification number, with the prefix "E" indicating approval by the European Community. These additives, performing antimicrobial and antioxidant functions, inhibit the growth of bacteria and oxidation, protecting products from spoilage. Preservatives are widespread in instant soups, crab rolls, processed raw meats, fruits and sausages. On the other hand, there is a tendency to use natural alternatives to protect against disease-causing bacteria.

Natural preservatives

Natural preservatives, such as rosemary, hop extract, salt, sugar, vinegar, alcohol, fennel and castor oil, are an alternative to chemicals in the world of canning. They are not only more familiar and natural for the human organism, but also with a significantly lower risk of consumption. Lemon juice, citrus juices and vitamins C and E also have a preservative function. These natural ingredients are widely used as auxiliaries in combination with other preservatives. However, in some cases they may be undesirable, such as in the market where dried fruit with a high content of added sugar is labelled as "natural form" due to marketing strategies.

Antioxidants

Biologically active substances - antioxidants, which can bind free radicals, are end products of metabolism and can destabilize cells. This process suppresses the formation of tumour

cells and slows down aging in the human body. Antioxidants are defenders against the development of cancer and cardiovascular diseases. They also improve immune protection and the body's resistance to harmful external influences [6, 7].

Chemical compounds in food leading to health problems

Most of the foods on our shelves also contain artificial chemicals and additives known to harm the human body. In modern crop and animal husbandry, foods often contain chemical contaminants causing serious health issues.

Pesticides used in agriculture cannot be controlled effectively, as much of the residual pesticides in vegetables and fruits are difficult to remove. Antibiotics are used in raising food animals, which can lead to disease resistance in humans. Hormones released into the environment are also reflected in the food chain. Genetically modified organisms included in the food chain can cause unknown changes in the human genetic system.

Some examples for food supplements

Sodium nitrate: Added to processed meats to stop bacteria growth. Associated with cancer in humans.

Sulfites: Used to keep prepared foods fresh. It may cause breathing difficulties in people sensitive to the ingredient.

Monosodium glutamate (MSG): A flavour enhancer that can cause headaches.

Some examples for food sweeteners

Aspartame: Can cause dizziness, headache, blurred vision and stomach problems.

High fructose corn syrup: A sweetener made from corn starch from genetically modified corn. It causes obesity, diabetes, heart problems, arthritis and insulin resistance.

Tert - Butylhydroquinone: Used to preserve fish products. May cause stomach tumours at high doses.

Food E Numbers

Nowadays nutrition is becoming more and more like an industry. Long before genetically modified foods, steroids and chemistry found their way to our table. A new nomenclature was gradually built up: many of the agents in food are no longer declared directly, but only numbered according to the popular "E" system.

Some of the most harmful E's

E102-tartazine (yellow #5) - There is evidence that it provokes asthma, allergic reactions and is associated with the development of thyroid tumours

E110-sunset yellow (yellow #6) - Side effects - urticaria, stuffy nose, allergies, sweating, hyperactivity, kidney tumours, chromosomal damage, nausea and vomiting, indigestion, loss of taste

E123-amaranth (red #2) - especially dangerous during pregnancy, as it can cause damage to the fetus

E122 and E124 (red #4) - derivatives of coal tar. They can cause asthma and allergic reactions

E127-erytosin (red #3) - can cause photosensitivity and has been shown to cause thyroid cancer in animal tests

E102, E104, E107, E110, E120, E122-E133, E142, E151, E153-E155, E173-E175, E180 are banned in some countries, but in others (including our country) they are still used.

CONCLUSIONS

Knowledge related to the use of foods containing food additives, as well as to chemical technologies in nutrition, serve to enrich the nutrition culture of young people. They are informed about the beneficial ingredients, as well as about some harms of food additives on human health. This is a good basis for young men and women to develop into healthy, energetic, active and capable people. By studying the field of food chemistry and choosing majors related to

nutrition, young people will be useful with their knowledge, experience and advice.

References

1. D. Tasheva, K. Atanasov, Textbook for profiled preparation in Chemistry of organic substances, Prosveta Publishing House, 2020.
2. https://vegadiet.bg/flavorings-in-foods/, J. Science and Dietetics, retrieved 2024/04/03, (in Bulgarian).
3. S. Simeonov, https://www.bb-team.org/articles/4521_konservantite#himicheski-konservanti, retrieved 2024/04/03, (in Bulgarian).
4. Washington, DC: The National Academies Press, 2006. Russell, N. J., and G. W. Gould. Food Preservatives, 2nd ed. New York: Kluwer Academic/Plenum Publishers, 2003.
5. fda.gov/opacom/backgrounders/problem.htmlndashfood, retrieved 2024/04/03
6. https://bg.m.wikipedia.org/wiki/%D0%90%D0%BD%D1%82%D0%B8%D0%BE%D0%BA%D1%81%D0%B8%D0%B4%D0%B0%D0%BD%D1%82, retrieved 2024/04/03, (in Bulgarian).
7. https://www.rzi-vt.bg/zhr.htm, retrieved 2024/04/03, (in Bulgarian).
8. https://rozbul.com/alkoholna-fermentatsiya/, retrieved 2024/04/03, (in Bulgarian).