Organic Acid and Active Compound in Fermented Milk : Areview

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Abstract

Fermented dairy products are one of the modern requirements for obtaining functional foods that provide energy and beneficially modify the metabolic functions in the body and reduce the risk of disease. It is also a rich source of nutrients for humans, including proteins, fats and carbohydrates, and a good means for the growth and reproduction of microorganisms.The fermentation process is the fastest method to produce many organic and functional foods, as the lactic acid bacteria used in fermentation prevent the growth of pathogens that cause spoilage of fermented foods or As antioxidants, because they contain biologically active compounds such as organic acids and active compounds that result from the decomposition of milk components by the action of lactic acid bacteria, including Lactobacillus and Lactococcus. This review included a study of the effect of organic acids and active compounds formed in milk after fermentation by lactic acid bacteria on the growth of microorganisms and as antioxidants.

Key Words: Organic Acid, Fermented Milk, diacetyl, acetone, estldehyde, antibacterial substances

DOI Number: 10.14704/NQ.2022.20.11.NQ66299 **NeuroQuantology 2022; 20(11):2902-2905**

Introduction

Fermented dairy products since ancient times have attracted attention due to their health-promoting effects. The process of fermenting milk is a natural phenomenon produced by lactic acid bacteria. and it works to coagulate milk, raise its acidity, and make organic molecules simpler and easier to digest. It also leads to increasing the shelf life of perishable foods, improving sensory properties, and the best way to deliver probiotics to the human body and improving immunity (Kaur et al., 2020). Milk is one of the most important foodstuffs that contain many nutritional components, including proteins that are classified as GRAS, which are generally recognized as safe because they are rich in sulfur-containing amino acids, which act as anti-microbials, cancers, viruses, and enhance immunity, as well as being used in many food industries (Al-Hatim et al.,2020).The main role of lactic acid bacteria during fermentation is the production of lactic acid and some other organic acids such as formic and acetic acid, as well as changes in the texture of products and the production of flavor compounds such as diacetyl, acetone, estldehyde and antibacterial substances. As these bacteria are classified on the basis of temperature into mesophilic bacteria that grow at 40-30 °C and thermophilic bacteria that grow at 60-50 °C.It can also be classified on the basis of its fermentation into homofermentative bacteria that produce only lactic acid, and heterofermentative bacteria that produce ethanol besides lactic acid (Kumar et al., 2015). Robinson and Tamime (1990) classified the fermentation process of milk based on the type of microorganisms used in the fermentation into lactic fermentation by lactic acid bacteria, which are of three types: Mesophilic, Thermophilic and Probiotic. The second is the fungal lactic fermentation, which is produced either by lactic acid bacteria and yeasts, as in kumis and kefir, or by fermentation by bacteria and molds, as in villi. Lactic acid bacteria inhibit the negative effects of hypothyroidism, reduce total and LDL cholesterol, and increase HDL cholesterol, which reduces the risk of heart disease and arterial hypertension (Nasser et al., 2021).

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Røssland et al. (2005) identified the fermentation products, which are organic acids, including lactic acid, which raises the acidity of the fermented product, which leads to the inhibition of pathogenic bacteria due to the ability of lactic acid bacteria to degrade protein. The production of moderate amounts of acetic acid during fermentation, which is a preservative and inhibitor more than lactic acid due to the high value of Pka in it and thus prevent the growth of yeasts, moulds and bacteria. Walait et al. (2022) described the synthesis of organic acids as carboxylic acids containing the (COOH-) group, and they are either strong or weak organic acids, including lactic, acetic and formic acid, and they are produced by different techniques, including fermentation, which is used in the beverage industry, food preservation, flavour enhancers and the elimination of many of pathogenic microorganisms. Ricke (2003) also indicated that organic acids are straight chain saturated monocarboxylic acids that have anti-bacterial activity as they reduce bacterial growth by lowering the pH, which prevents their growth.It also penetrates the fatty membrane of the bacterial cell and affects the neutral pH of the cytoplasm of the cells, which affects the bacteria that must maintain a neutral cytoplasm, which leads to the consumption of ATP and energy depletion. The levels of active organic compounds also affect the sensory properties of fermented milk and the health benefits, and the fermentation period has an effect on the variation in the concentrations of these compounds, including acetyldehyde, diacetyl and acetone due to the different metabolism of lactic acid bacteria.As for propanal 2-methyl-, 2-methyl-butanal and 3-methyl-1-butanal, they are produced by the representation of the amino acids valine, isoleucine and leucine, respectively, during fermentation by yeasts (Gadaga et al., 2007).

organic acids

Organic acids are organic compounds with acidic properties containing non-nutritive carbon that result from the decomposition of carbohydrates by lactic acid bacteria. 2015).Lactic acid bacteria decompose lactose into lactic acid to generate the energy needed for the synthesis of biomass that takes carbon and provides energy. Tamime). The high concentration of lactic acid and its control over other acids is related to its ability to utilize proteins, fats and lactose by lactic acid bacteria (Gebreselassie and Beyene, 2016). As for succinic acid, it is a by-product of the fermentation process, which is produced when glucose is converted after the decomposition of lactose into two molecules of phosphoenolpyruvate and then to oxaloacetic acid and thus to malate after its reaction with two hydrogen molecules and then to fumarate and succinate. Pyruvate is transduced into pyruvate and then into lactic as a result of fermentation et al. 2022) Walait). As for pyruvic acid, it is an intermediate product of glucose and citrate metabolism by the action of lactic acid bacteria (Gebreselassie et al., 2016). Citric acid is also found in low concentrations due to the role of lactic acid bacteria in citrate metabolism (Gebreselassie and Beyene, 2016). It was found (Gebreselassie et al., 2016) that the concentration of citric acid ranges between 52 and 1712 µg/g because the representation of citrate in lactic acid bacteria is very low and it is consumed at pH 6.9, while its absorption is at 4.5. Because of the increase in the permeability of cell membranes at low acidity. Tamime et al., 2006).Lactic acid bacteria are among the most suitable microorganism strains for the treatment and prevention of diseases due to their ability to adhere to intestinal cells and treat gastrointestinal diseases. It works by inhibiting the growth of many pathogenic bacteria, including E. coli enteropathogenic, enterotoxigenic E. coli, and Klebsiella pneumoniae for their ability to produce metabolites that inhibit pathogenic bacteria such as organic acids and bacteriocins, which show wide anti-bacterial activities because they provide an acidic environment inappropriate for the growth of pathogenic bacteria. bacteria and thus inhibiting their growth. (Forestier et al., 2001)Savadogo et al. (2004) indicated that the organic acids produced by lactic acid bacteria during lactic fermentation lead to a prolongation of the shelf life of perishable foods.Røssland et al. (2005) mentioned that organic acids that raise acidity inhibit pathogenic bacteria because lactic acid bacteria have the ability to degrade protein, including acetic acid, which is a more inhibitory preservative than lactic because of its high Pka value and preventing the growth of yeasts, molds and bacteria. George (2004) indicated that the inhibitory activity of bacteriocins increased in the presence of organic acids, as bacteriocins are characterized by low molecular weights and are easily degraded by proteolytic enzymes, as well as ease of movement and thus adhesion to the bacterial cell and penetration of the outer cell wall Which causes a deterioration in its DNA and inhibits the synthesis of peptidoglycan.

The bacteriocins produced by lactic acid bacteria have a wide range of inhibition of pathogenic bacteria and bacteria that cause food spoilage.(Wali and Abed., 2019) found that acetic acid has health benefits as it is considered an antimicrobial for bacteria resistant to different types of antibiotics, including E. coli, Pseudomonas aeruginosa due to its effect on the bacterial cell membrane.The cell wall of negative bacteria contains a layer estimated at about 80% of lipopolysaccharides, which prevents the anti-material from reaching the peptidoglycan layer below it, which is present by 20%, while it is less in positive bacteria as well as its effectiveness in breaking the glycosidic bond that binds the peptidoglycan layer and thus destroys the cell wall And inhibition of the growth of these bacteria (Mine et al., 2004).

Active Compounds

There are many biologically active compounds that belong to different classes, including alcohols, aldehydes, alkanes, alkenes, amines, amides, carbohydrates, carboxylic acids, organic and fatty acids, and ethers Ketones and esters, which have a role in improving the nutritional, functional and therapeutic qualities of fermented dairy products, have anti-inflammatory activities for many diseases, including allergies, Alzheimer's, arthritis, cancer, diabetes, depression, fungi and convulsions and infections, microbes, malaria, nephrotoxicity, oxidative stress, fever, tuberculosis, tumors, viruses, and others (Sharma et al., 2021).The resulting active compounds degrade milk caseinate by the action of proteases. Antioxidants have an activity similar to the industrial antioxidants BHT, due to the difference in the effectiveness of types of lactic acid bacteria strains in reducing free radicals that cause oxidation due to the difference in the metabolism of different types of bacteria (Zanutto-Elgui et al., 2.19). . The active compounds and flavoring compounds are present in raw milk in small quantities compared to fermented dairy products, which indicates that the presence of these compounds increases during fermentation due to the decomposition of amino acids by Lactobacillus and Lactococcus bacteria.The difference in their concentrations is due to the different metabolism of microorganisms et al., 2007 (Gadaga et al., 2007).Lactose is the source of stildehyde, diacetyl and acetoin after fermentation. The main volatile compounds responsible for giving flavor are carbonyl and acetone compounds, and they are found at a concentration of 4–23 mg/kg, diacetyl and acetone.Although they are produced in small quantities, acetoin and butanone are produced in addition to the production of lactic acid and some other acids produced when 20-40% of lactose is fermented.It is responsible for giving the distinct flavor to dairy products. The main alcohol is ethanol, which results from the breakdown of glucose and amino acids, and it is found at a concentration of 0.2-9.9 mg/kg (Cheng, 2010).Tamime et al. (2006) mentioned that acetaldehyde is a major flavor compound with a concentration ranging from 10-40 µg/g. It is reduced to ethanol and its concentration depends on the fermentation stage and temperature, as its concentration decreases with decreasing temperature and length of fermentation period.

Diacetyl is produced during the conversion of citric acid to pyruvate in milk using lactic acid bacteria. Ka¨lvia¨inen et al., 2003.Gebreselassie and Beyene (2016) identified a group of ketones, diacetyl, acetoin, and 2,3-pentadione, resulting from the catabolism of citric acid by lactic acid bacteria. The concentration of diacetyl and acetoin was 2.8-0.007 µg/g after 48 hours of fermentation. As for ethanol, its concentration ranged between 190-2.7 µg/g after 48 hours of fermentationThe highest ethanol content was found in the product fermented with a pure strain of S. cerevisiae due to the esterification of fatty acids that contribute to the flavor of the fermented products as well as other alcohols including 3-methyl and 1-methyl.The active compounds have many health benefits, including 1,2-Benezenedicarboxylic acid, which is used to treat Alzheimer's, arthritis, and cancer, Dodecenoic acid is responsible for treating kidney disease, Glucopyranoside is an antibacterial, Benzoic acid is an antimicrobial, Propionic acid is an antifungal, and 1, 2-Benezenedicarboxylic acid, an anti-Alzheimer's Cancer and arthritis, 1-Docosene, the anti-bacterial, anti-cancer, anti-inflammatory, 9-Eicosene, the antioxidant, hyperglycemic, 3-Chloropropionic acid, the anti-depressant, and nephrotoxic.

(Gjorgievski et al., 2014) indicated that the highest value was 63.99 for milk fermented by Lactobacillus acidophilus and the lowest value was 39.43 for fermentation by Streptococcus thermophilus and Lactobacillus delbrueckii ssp. bulgaricus because the initiator strains used in the fermentation of different dairy products analyzed the primary components of milk such as proteins, carbohydrates and fats into secondary components

such as free amino acids, active peptides, organic acids and free fatty acids with health benefits of antioxidants.

Conclusions

Fermented dairy foods have a significant impact on human health through the production of organic acids and biologically active compounds through microorganisms. Fermented products can be widely used as the most effective way to deliver beneficial probiotic microbes to the body.Studies have shown that fermented dairy products (fermented milk, yoghurt, cheese, koumiss, kefir) helped in the immune response against pathogens by adding antioxidants, antimicrobials and antifungals.Anti-inflammatories, anti-diabetics, anti-atherosclerosis, and alleviation of allergy to milk protein, and thus a great opportunity can be provided for the development of functional dairy products supported by lactic acid bacteria that maintain human health.

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