REVIEW ARTICLE: DAIRY PRODUCTS, A GOOD RESERVIOR FOR TRANSFER PROBIOTICS

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Abstract

The human carries in his body about 1-1.5 kilogram of different microorganisms, which together represent the human microbiota, where everyone has there own microbial environment. This microflora plays a vitally important role and interferes with many of the body's various physiological, immune, and nutritional functions, which may change according to the variation of many conditions that occur in our life.

Probiotics are known as live microorganisms that give positive effects on host health when consumed in sufficient numbers.

Probiotics are considered one of the most distinguished safe strategies to restore the vital microbiota which is important to the environment of living organisms in the gastrointestinal tract, as studies have proven its unique ability in the prevention and treatment of many diseases for young and old age people. Probiotics are available commercially in many different formulas and pharmaceutical forms (capsules, pills, tablets, etc.), which may be blamed for many disadvantages, as many complaints were recorded against some international companies producing. This matter encouraged those interested in the food industry field to move towards manufacturing functional foods as therapeutic nutritional products with a high number of live probiotics to achieve the health effect for humans, especially the various dairy products, which are considered one of the best food vehicles to contain and deliver these probiotics, due to their many advantages. This study aimed to highlight the importance of including food with probiotics, specifically dairy products, and preference it on pharmaceutical forms in order to deliver its nutritional and health benefits to humans.

Keywords: gut microbiota, probiotics, pharmaceutical forms, dairy products.

مقالة مرجعية : منتجات الالبان ... مستودع جيد لنقل المعززات الحيوية

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الخلاصة

يوجد بداخل جسم الانسان قرابة 1.5 كيلوغرام من الكائنات الحية الدقيقة المختلفة والتي تشكل مع الجسم الذي تتواجد بداخله ما يعرف بالميكروبات البشرية ، اذ ان لكل انسان البيئة المايكروبية الخاصة به . هذه البكتريا تلعب دورا حيويا ومهما داخل جسم الانسان ، حيث انها تتداخل مع العديد من وظائف الجسم الفسيولوجية والتغذوية المختلفة والتي قد تتعرض الى تغييرات بدورها تبعا لتنوع التغييرات والظروف في داخل جسم الانسان . تعرف الكائنات الحية الدقيقة التي تعطي تايرات ايجابية على صحة العائل والمضيف عند استهلاكها باعداد كافية بالمعززات الحيوية وهي تعتبر من أكثر الإستراتيجيات الآمنة والاكر تميزًا في تعزيز المناعة في داخل الجهاز الهضمي من خلال قدرتها على طرد الاحياء المجهرية الضارة والحلول محلها ، حيث أثبتت الدراسات العديدة قدرتها في الوقاية والعلاج من العديد من الأمراض للشباب وكبار السن. تتوفر المعززات الحيوية تجاريًا بصيغ واشكال صيدلانية مختلفة (كبسولات ، حبوب ، أقراص ، إلخ) لكنها تعاني بدورها من العديد من العيوب التي تتعلق بصناعتها، حيث تم تسجيل العديد من الشكاوى ضد بعض الشركات العالمية المنتجة وهذا الأمر شجع المهتمين بمجال الصناعات الغذائية على التحرك نحو تصنيع أغذية وظيفية كمنتجات

غذائية علاجية تحوي على عدد كبير من المعززات الحية لتحقيق الأثر الصحي للإنسان ، وخاصة منتجات الألبان المختلفة ، والتي تعتبر من أفضل المركبات الغذائية لاحتواء وتوصيل هذه المعززات ، لما لها من مزايا ايجابية عديدة. هدفت هذه الدراسة إلى إبراز أهمية تضمين الاغذية بالمعززات الحيوية ، وتحديداً منتجات الألبان ، وتفضيلها على الأشكال الصيدلانية من أجل إيصال فوائدها الغذائية والصحية للإنسان.

الكلمات المفتاحية: مايكروفلورا الامعاء ، المعززات الحيوية ، الأشكال الصيدلانية ، منتجات الألبان.

Introduction

The gut microflora of the gastrointestinal tract

Human carries a mass of microorganisms of approximately 1-1.5 kilogram, which means about 10^{16} cells compared to 10^{14} human cells [1 , 2, 3]. It is classified into more than 2000 types of both beneficial and harmful organisms [4], where these organisms form part of the body's natural physiology and play an important role in functions through several axes: -

1- Interferes with vital bowel functions by producing short-chain fatty acids (SCFAs) such as butyrate, which is an important nutritional supplement in many different body functions [5].

2- Production of secondary metabolites and vitamins, whose low levels lead to the development of malnutrition diseases [6].

3- As a therapeutic and drug regulator [7].

4- Effect on energy sources by raising the efficiency of the metabolism of glucose and fats.

5- Strengthening and developing the immune system [8].

6- Recycle the water and salt content in the intestine.

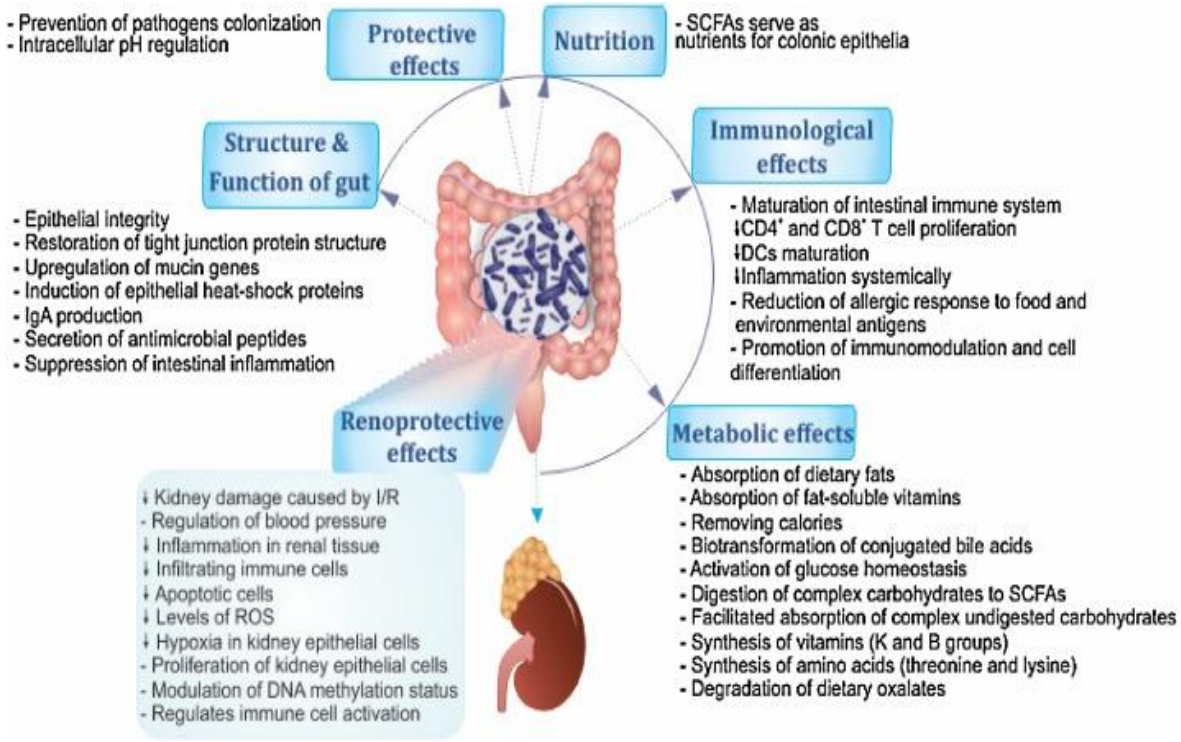

Figure (1) indicates the most functions of the gut microflora in the human body [9].

Many researchers refer to the existence of several factors that contribute directly or indirectly to changing the biological ecosystem of the gastrointestinal tract and cause the distorted balance of intestinal flora, such as smoking, different age stages, stress, diabetes, and metabolic syndrome in food-sensitive patients [10

,11] and the indiscriminate use of antibiotics [12; 13] as well as the incidence of some diseases such as Irritable Bowel Syndrome (IBS), which causes a decrease in the number of beneficial bacteria in the intestine [14] and autism (15; 16). In addition to environmental factors such as stress, severe headache, excessive physical stress to the body that threatens life, and other factors that lead to disturbance the balance of intestinal flora [17]. often studiesobserved a decrease in the number of bacteria producing butyric acid and starch-degrading types in patients fed through nutrients[18; 19].

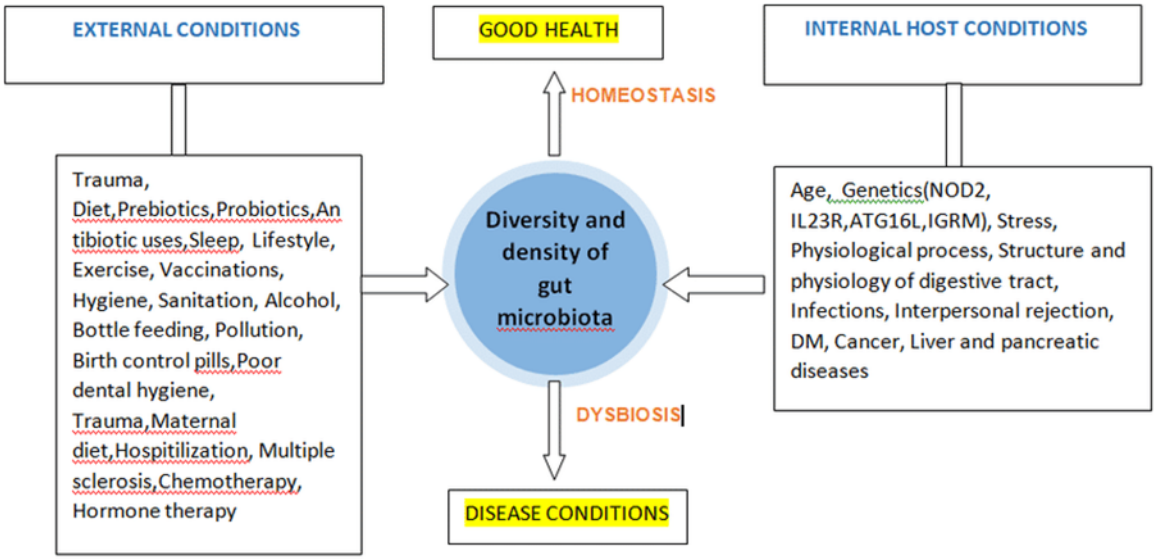

Figure (2) The most important factors that change the physiology microflora of the human gut [20].

The probiotics have the attention of scientists and researchers, as many studies indicated the important role played by these organisms as supportive biosystems to restore the microbial balance of the intestinal flora, strengthening the body's defenses and developing immune systems [21] ,which have the beneficial effects on host [22].Restoring the normal physiological balance of the intestinal flora requires the presence of 85-80% of friendly microorganisms that impede the colonization of pathological microbes such as Salmonella, Vibrio cholera, Escherichia coli, and others [23].

Probiotics

According to the definition of the World Health Organization (WHO) and Food and Agriculture Organization (FAO), probiotics are live microorganisms that, when consumed in sufficient numbers, give positive effects on the health of the host [24].While defined probiotics as living microbial cultures that when consumed give many benefits to the health of the host by creating a delicate balance between the gut and the immune system [25] . It has also been defined by the World Gastroenterology Organization as living microorganisms that can be found in foods, nutritional supplements, and medicines [26]. It was defined as a single or mixed culture of living microorganisms that enhance the health of the host by creating a balance in the gut microbiota of the gastrointestinal tract [27].Also defined, as non-pathogenic living microbial supporters that give positive and beneficial effects on the health of the host [28]. They are known as nutritional supplements from live microorganisms that give beneficial effects on host health by restoring balance

to the intestinal flora. [29]. There are other studies defined it as non-pathogenic living microorganisms (yeasts or bacteria) that

restore the balance of the intestinal flora of the human gastrointestinal tract to confer health benefits. Besides its therapeutic and nutritional effects in animals [30 , 31].

In some years, probiotics have gained importance in the medical and commercial fields, as a new global trend to adopt it as an alternative treatment to antibiotics for the treatment and prevention of many diseases [32]. As well its commercial importance as a therapeutic and functional food with numbers not less than 10^7 CFU / g in food manufactured to create the required health effect and enhancing the body's defenses [33,34].

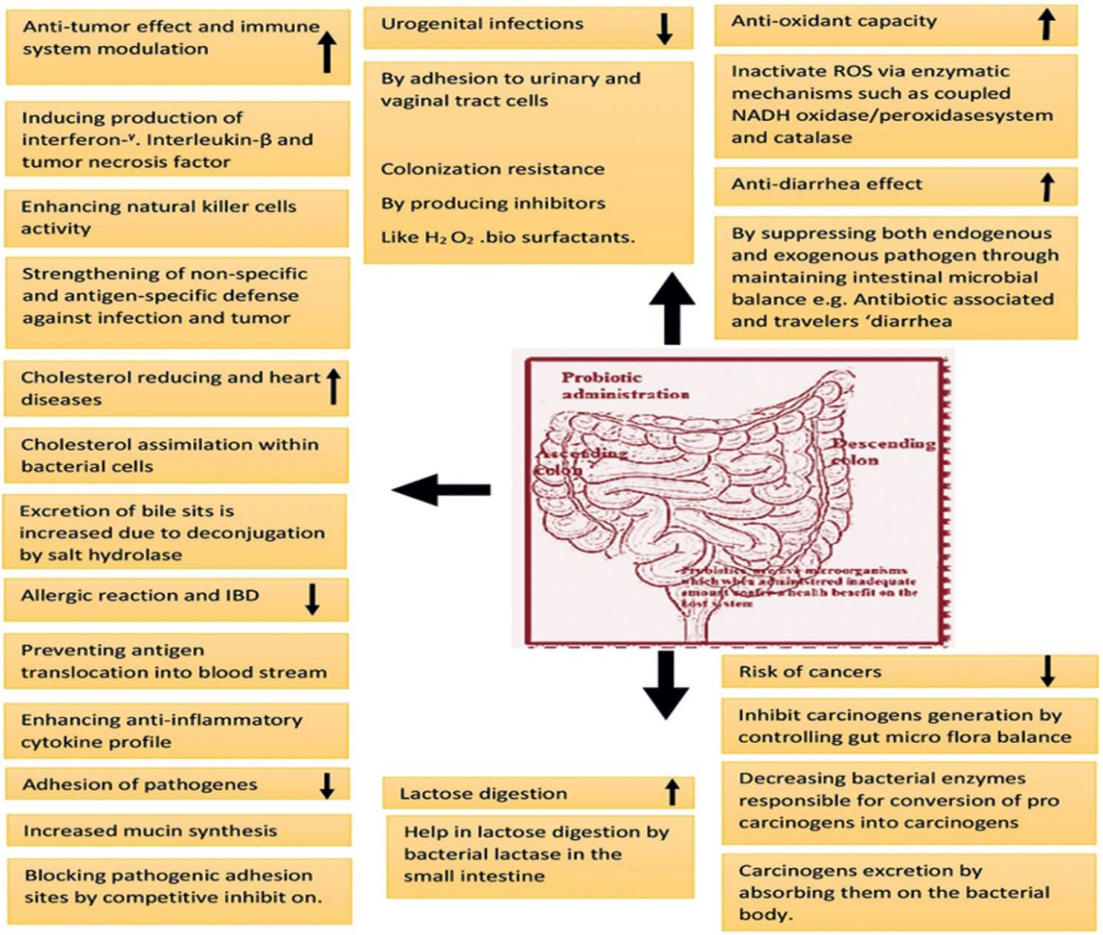

Figure (3) shows the most important mechanisms used by probiotics to create the health effect associated with their consumption [35].

History of probiotics

The word "probiotic" originates from the Greek language and consists of two parts, the first (pro) which means for and the second part (bio) which means life. This contradicts with the term antibiotic, which means against life [36]. The term probiotic was used for the first time in 1953 by Warner Kollath [37].The importance of these organisms became evident in the twentieth century, particularly by the Russian scientist Eli Mitchenkov, when he observed that the Lactobacilli bacteria present in lactic ferments have the ability to create a positive effect on the intestinal flora of the human digestive tract [38]. Based on these facts, Metchnikoff laid the scientific

basis for his theory, according to which the aging process in the human body begins with food poisoning as a result of the action and activity of pathogenic microorganisms in the gut. He linked his findings when he observed the long-life of rural residents of the Caucasus, which he attributed to their dependence mainly on fermented milk with lactic acid bacteria in their foods. Metchnikoff personally acidified the milk with lactic acid bacteria, consumed it and called it (Bulgarian bacilli). Metchnikoff won the Nobel Prize in 1908 for this discovery [39]. In 1950, probiotics were used to treat pigs infected with pathogenic *E. coli* bacteria after being authorized by USA ministry of Agriculture [40]. Lilly and Stillwell referred to it in 1965 as an indication of material secreted by microorganisms. In 1974 Mann and Spoeing discovered the role of fermented milk in lowering blood cholesterol, and later in 1979 Hull discovered the first type of probiotic, which he called *Lactobacillus acidophilus*, and then in 1991 *Bifidobacterium bifidus* bacterium was diagnosed as a probiotic, then in 1994, the World Health Organization (WHO) showed great interest in probiotics as a new strategy that develops and increases the body's immune defenses to reflect a positive effect on the health of the host [41] .(Table 1) shows the most important probiotics [42,43].

Table (1) The most genera of microorganisms and their species are used probiotics

The genera	The species
Lactobacillus	L.acidophilus , Lb.bulgaricus , L..casei , Lb.crispatus , L. fermentum , Lb .gasseri , L.lactis , Lb.paracasei , L.paraplantarum , L .johnsonii , L.salivarus , L . plantarum , L .rhamnosus,L b .reuteri , L. brevis , L. crispatus , L. curvatus , L. gallinarum , L.helveticu
Bifidobacterium	Bifidobacterium catenulatum , Bifidobacteirum animails , Bifidobacterium adolescentis , Bifidobacteirum bifidum , Bifidobacteirum breve , Bifidobacteirum infants , Bifidobacteirum longum
Lactococcus	Lactococcus cremoris, Lactococcus lactis
Streptococcus	Streptococcus thermophiles , Streptococcus oralis , Streptococcus sanguis , Streptococcus mitis , Streptococcus salivarius
Probionoibacterium	Probionoibacterium jensenii , Probionoibacterium freudenreichii
Leconostoc	Leconostoc reffinolactis , Leconostoc mesentroides
Pediococcus	Pediococcus acidilactici , Pediococcus pentosaceus
Bacillus	Bacillus cereus , Bacillus coagulans , Bacillus subtilis , Bacillus laterosporus
Enterococcus	Enterococcus faecalisa , Enterococcus faeciuma
Bacteroides	Bacteroides uniformis
Escherichia coli	Escherichia coli Nissl
Clostridium	Closteridium botyricum
Peptostreptococcus	Peptostreptococcus productus
Akkermansia	Akkermansia muciniphila
Geotrichum	Geotrichum penicillium , Geotrichum candidum
Saccharomyces	Saccharomyces boulardii

Features of a good probiotic

A number of characteristics that must be present in the organisms intended to be used as probiotics [44]: -

1- It has the ability to survive when it crosses the mouth and stomach down to the intestines.

2- Resistant to stomach acidity and hydrolysate intestinal enzymes.

3- The ability to tolerate high concentrations of bile salts in the upper part of the intestine.

4- It has the ability to adhere to the epithelial cells lining of the intestine.

5- It must be non-toxic and non-pathogenic.

6-It has the ability to produce antimicrobial substances that inhibit the growth of microorganisms [45].

7. Give the host the required health benefits for which it was taken.

8- Provides balance to the gut microbiota.

9. The ability to grow rapidly in large numbers.

10. The ability to survive in large numbers during the storage period of processed food products to provide the benefit to the consumer.

Pharmaceutical forms of probiotics

Probiotics come in different pharmaceutical types, as they are available either in a dried or powdered form inside capsules in single or mixed farms of several strains of probiotics [46]. many of these products lack quality control standards during the production stages, many studies have indicated the wide differences related with the quality and contamination of these pharmaceutical products [47].14 commercial products in the United States of America have been selected to inform their conformity with the established standards, it was found that 93% of them contain wrong information in the explanatory label of the package, 57% are contaminated, and 36% of the products do not contain the strains mentioned on the label. [48]. 58 commercial products from Europe, Britain, Canada, Japan and countries from Asia have examined, it was found that only 38% of the products contain the dose affixed on the label and 29% of them did not contain the strains fixed on the label, these researchers attributed the reason for the deterioration the quality of these products, to the failure of the companies to apply the standards and specifications of quality control and don't obligate Good Manufactured Practices policies. Besides, most of the manufacturers affirm on the label that the products contain at least 1 x 10^9 CFU/ mg, while laboratory tests indicated that it contained less than the mentioned dose at a high rate, which makes it lose the curative or preventive character. [49]. In a study, six of commercial S. boulardii products, manufactured by Flomicin (Neochemical), Floratil (Merck), Floratil (Herald's) companies , it was found that only 50% of them matched the concentration affixed to the label as the Floratil (Merck) company product contained high levels of *S. boulardii* yeast reached 1 x 10^9/100 ml and the yeast maintained its viability during the next six months at numbers of 9.5 x 10^8 , in contrast, the product of Lactipam (Sigma pharm) company contained 2 × 10^4 CFU , which is much less of what was mentioned on the label information. [50].

Preference foods with probiotics on pharmaceutical formulas

For the previous reasons, and in order to make the most of the beneficial effects that the probiotics add to the human, food producers have resorted to manufacturing various kinds of products that contain beneficial organisms [51,52] .where the global markets abound with many types of fermented and non-fermented foods in different and multiple forms to satisfy the requirements of consumers, such as alcoholic and non-alcoholic drinks,

fermented meats, fermented fish, vegetables, baked foods, various kinds of dairy products and others [53], currently, there are more than 5,000 types of commercial foods containing beneficial organisms, most of these are probiotics in the global markets, especially dairy products, because of their suitability to maintain the bacterial probiotics with high efficiency until delivery to the human intestine to perform their required therapeutic role.(Table 2) [54,55,56,57,58].

Table (2) Dairy and nondairy foods contain probiotics

dairy foods contain probiotics	
Dairy	Name of product
(a)drinkable milk	Acidophilus milk drink, acidophilus sweet drink, Dairy fermented beverages, fermented goats milk, whey - protein-based drinks, kefir drink, Yakult culture milk.
(b) yogurt	Fruits -based- yoghurt, corn milk yoghurt, frozen yoghurt, regular full- fat yoghurt, traditional Greek yoghurt, Activia,
(c) Cheese	Cheddar cheese , cottage cheese , feta cheese , goat semi-solid cheese ,mozzarella cheese .
(d)another product	Acidophilus butter, frozen dairy desert , low-fat ice cream , probiotic ice cream , yog – ice cream.
Non- dairy foods contain probiotics	
Vegetables	
(a)drink	Tomato drink, carrot drink, ginger drink, cabbage drink,beets drink, onion drink, soy stirred yoghurt (like a drink), fermented soymilk drink, peanut milk drink.
(b)another product	Fermented vegetables
Fruits	
(a)drinks	Green coconut water, cranberry, orange, apple, carrot, blackcurrant , noni , cashew , banana and grape juices .
(b) another product	Fermented banana pulp , fermented fruits , dried fruits , probiotic banana puree , nonfermented fruit juice beverages .
Cereals	
(a) drinks	Millet, wheat, rye, maize and others fermented probiotics beverages.

(b) another product	Oat,malt and other cereals drinks Rice yogurt , cereals puddings .
Meats	Dr fermented sausages, Fermented fish products
Another product	soy stirred yoghurt (like drink) , fermented soymilk drink , nonfermented soy-based frozen deserts , probiotic cassava - flour product .

Dairy products with probiotics

Dairy products supplement with probiotics dominated the market and their sales expanded in many countries of the world. According to an analysis study (2016) for the global market, the volume production of fermented dairy products and fermented milk drinks in the European markets increased from (18,912) Mt in 2000 to reach 35,529 Mt in 2015, it's expected that the volume of production will increase to (43,136) Mt by 2025 [59, 60]. Many factors contributed to encouraging the manufacturers for producing probiotics' dairy products compared with other food products. Perhaps the most important reasons that motivated food manufacturers in producing these products [61]: -

- The use of refrigerated storage to preserve dairy products enhances the survival of the probiotics in the manufactured products for a longer period of time and with high numbers.
- Dairy products act as a protection to maintain the stability of the probiotics when it crosses the human digestive system and reaches the intestine, to settle there.
- Contributing to increasing the numbers of probiotics in dairy products from hand, and inside the human gastrointestinal tract on the other hand, by inter the prebiotics to these products during manufacturing.
- Dairy products are among the best products accepted by the consumer for describing them as therapeutic products, in addition to the nutritional value given by the milk involved in the production.
- It is considered one of the foods that satisfy consumers' tastes due to different varieties and flavors.Enter of various types of probiotics, especially bacterial species, enhanced to manufacture many kinds of dairy products, which include milk, fermented milk, yoghurt, cheeses, as well as butter and ice cream, which are distinguished by their differences according to the type of probiotic that is included in their production. L.acidophilus, L.casei, L. rhamnosus and L. plantarum, are the most commonly used in the manufacture of milk drinks [62]. Amixture of several probiotics' strains was used which are: S.thermophilus, L.bulgaricus, L.acidophilus and B.lactis to manufacture a fermented milk drink flavored with a cocktail of several fruits (red grapes, cornelian cherry, black mulberry). The results showed the efficacy of the manufactured product in maintaining high live numbers of the four probiotics (above 1×10^6) throughout the cold storage period as well as improving the sensory properties [63].

Aloe vera pulp was used at different concentrations and co-culture of Lactobacillus acidophilus CH-2, Streptococcus thermophilus CH-1, Lactobacillus lactis CHIDRT-VAC, Lactobacillus helveticus CNRZ32, Lactobacillus casei FEGY9973, Lactobacillus plantarum 4496, Lactobacillus bulgaricus LB-12, Lactobacillus rhamnosus 306 , Bifidobacterium bifidum 15,969 to manufacture of UF soft cheese by using full cream UF-retentate. It's clear that the

use of Aloe vera pulp contributed to increasing the logarithm of the live numbers of probiotics about one logarithmic cycle after 4 weeks of storage period [64].A mixture of several probiotic strains was used, including two strains of *S.thermophilus* bacteria and two strains of *Lb.bulgaricus* bacteria isolated from yoghurt produced from goat's milk in addition to the probiotics *Lb.paracasei* and *Lb.acidophilus* , which were isolated from the faeces of newborns to produce milk Low fat from goat milk. The result showed that the use of a joint culture of several strains of probiotics enhance the sensory and microbial properties of the manufactured product during the 14-day cold storage period at 4 ° C [65] The samples of fermented milk made from cow's milk, goat's milk and a mixture of them by using S.thermoplilus, L.delbrueckii ssp. bulgaricus (CH-1) and L.casei were maintained in numbers above 6 logs CFU / g of live cells throughout the 28-day storage period at 4 ° C for all probiotic strains [66]

The sensory, rheological and microbial properties of the fermented milk product from goat milk, were also studied, by using single cultures of three strains of Bifidobacterium including B.lactis AD606, B.lactis BB 12 and longum Ad50. B .lactis AD606 and B.lactis BB 12 . Fermented dairy product samples maintained a good number of live cells during a three -week cold storage period at 5° C [67].A study was conducted to find out the effect of adding stinging honey on the properties of cheese made from goat's milk containing L.acidophilus LA-5. The honey contribution to increasing the number of probiotic cells in all manufactured cheese samples and maintaining high viability (above 6 log CFU/ml) [68].A comparable result was found when the cheese was manufactured from goat's milk was supplemented with three strains of probiotics B. longum, Enterococcus faecium, and L. paracasei. The manufactured samples maintained high viability of the probiotics in addition to a significant increase in the percentage of volatile fatty acids and improved aroma for cheese produced during the maturity period [69]. The effect of the milk quality used in the manufacture of lactic ferments on the sensory, physiochemical and microbial properties was investigated by adding a co-culture of S.thermoplilus, L.bulgaricus and L.casei ATCC393 into three types of milk: goat's milk, cow's milk and a mixture of goat's milk + cow's milk in a ratio of (1:1). All manufactured fermenters maintained high live numbers of probiotics, higher than (7.5 log CFU/g) throughout the 28-day refrigerated storage period at 4 ° C, with the preference of the dairy fermenter made from a mixture of goat's milk + cows [70].

A subsequent study indicated the efficiency of dairy products (yoghurt, fermented milk drink, ice cream and cheese) made from goat milk in maintaining high live numbers of the probiotics during the refrigerated storage period, thus delivering the health benefits of these probiotics to humans compared to products made from sheep and camel milk [71],As goat milk considers a good vehicle for delivering probiotics bacteria due to its high quality material for production and manufacturing functional foods [72].A mixture of flour, honey, cocoa and vanilla were adding to produce curd from goat's milk using *Bifidobacterium lactis* BB12 and Lactobacillus acidophilus. The manufactured product maintained a high viability of bacterial throughout the cold storage period above (7 log CFU/ml) [73].To understand the most important microbial, physicochemical and sensory indicators, ricotta cheese made from goat's milk was supplemented with two types of probiotics B.lactis BB 12, Lb. acidophilus LA-05, the above indicators were studied through the period of refrigerated storage

and the results showed that the manufactured cheese retained live numbers of probiotics (6 log CFU/g) with a homogeneous tissue. The probiotics continued to maintain their numbers even after studying the effect of extreme conditions in the human digestive system, thus indicating the suitability of ricotta cheese as a conducting and protecting food for probiotics during storage and conditions of the human digestive system [74].A paper demonstrated that the use of *L. plantarum* 564 probiotics as (free- and spray dried cells) form, in the soft acidic coagulated goat cheese, significantly increased bacterial viability of 8.82 log CFU/g after 8 weeks of storage and promoted the development of sensory and rheological characteristics that met consumer acceptance [75].The microbial, sensory and rheological properties of coalho cheese made from a lyophilized culture of *L.mucosae* CNP007 acid-producing isolated from goat's milk were investigated, the processed cheese samples were characterized with sensory acceptance by consumers in terms of colour, aroma, texture and flavour through the 28-day storage period, in addition to increasing the viability of bacteria at numbers higher than (10^8 CFU /g) [76].A mixed culture of probiotics, included, Bifidobacterium animalis *subsp.* lactis *BB*-12 ,Lb.acidophilus LA-05 and Propionibacterium jensenii 702 , were revealed, on the microbial, sensory and physical properties of fermented milk drinks (7 types) made from goat's milk. The three probiotics showed a synergistic relationship with each other in fermented milk samples throughout the fermentation and storage period in terms of sensory acceptability in addition to maintaining high viability of their numbers reaching more than (7 log CFU/g) [77].The using co-cultures of Bifidobacterium and Lactobacillus. B. Animals B0 L. acidophilus Ki, B. Animals B0 L.acidophilus L10, B. Animals B94 L.acidophilus Ki , B.animals B94 L.acidophilus L10 has an impact in the presence and absence of inulin on the microbial and physical properties of fermented milk samples made from goat's and sheep's milk during refrigerated storage for more than 21 days at 4 ° C. All co-cultures showed high viability in numbers of more than (7 log CFU/g) in samples made from sheep's milk, besides increased product stability by Inulin during storage [78].The effect of whey taken from goat's cheese manufactured with prebiotics(inulin and oligofructose) on the dairy drink produced from chocolate-enriched goat milk and supplement with *B.lactis* probiotic, was studied by [79]. All samples with high amounts of whey and prebiotics showed higher sensory properties in flavor and aroma, with numbers between (6-8 log CFU/g) in bacterial viability.A paper revealed that the ice cream produced from goat's milk and supplemented with B. lactis BLC1 retained high sensory properties and good viability of bacteria about 84.7% at logarithmic numbers (6-7 log CFU/g) throughout the 120 day storage period at -18 °C [80].The fermented dairy products were produced from skimmed milk with and without inulin addition by using four probiotic starter cultures: Lactobacillus plantarum, L.rhamnosus, L.reutri and L.acidophilus both separately. All samples containing inulin retained high numbers of probiotics after 10 weeks of cold storage at 5 ° C, as well as obtained the highest results of the sensory evaluation [81].

Ginseng extract was added in different proportions to fermented milk made by using Streptococcus thermophilus and Lactobacillus plantarum NK181 probiotics. The samples showed an increase in the numbers of live cells for the probiotics and antioxidant when using 1% of the ginseng extract as the best

proportion [82].The influence of the addition of exopolysaccharides produced by Lactobacillus plantarum JLK0142 on the properties of produced cheese was evaluated [83]. Cheddar cheese samples containing exopolysaccharides improvement the sensory and rheological properties with anumber of live cells (7.99 log CFU/g) after 90 days of ripening.

Despite depending on the producers and manufacturers on bacterial species in the manufacture of dairy products supplemented with probiotics, there are other types of dairy products that yeasts and molds enter in their production and manufacturing in many countries of the world such as kefir, Kumis, Mursik Villi, Shubat [84].The origin of kefir milk is the north of the Caucasus Mountains, it has therapeutic properties for treating many illnesses, as well as the high nutritional value and properties due to the content of mineral elements, vitamins, organic acids and volatile acids [85]. Kefir is made by fermentation of cow, sheep or goat milk with a mixture of starter culture consisting of bacteria and yeasts, which includes: Streptococcus thermophilus, Bifidobacterium bifidus, Lactobacillus acidophilus, Lactobacillus lactis, Lactobacillus delbrueckii subsp. Bulgaricus, Lactobacillus helveticus, Bifidobacterium bifidum, Lactococcus lactis, Lactococcus kefiranofaciens, Saccharomyces fragilis, Saccharomyces cerevicea, Torulaspora delbruckii, Kluyverces lactispora Kazomy, Kluyverces lactispora, Kazstana [85]

The characteristics of the kefir produced differ in flavor, texture and viscosity according to the type of milk prepared for manufacture and the variety of microorganisms in the starter culture that differs according to the geographical area and the prevailing food habits [86].Kefir was produced from vegetable soy milk by using a mixed culture of lactic acid bacteria and yeasts, which included Lactobacillus bervis, Lactobacillus helveticus, kefir Lactobacillu, Leuconostoc mesentroids, Kluyvromyces lactis, Kluyveromyces lactis marxianus, Kluyveromyces and Pichthysia marxianus [87] A co- culture of 11 strains of yeasts and bacteria was used, including Candida kefir, Saccharomyces lactis, Lactobacillus casei, Leuconostoc mesentroides , Lactobacillus brevis, Lactobacillus kefir, Streptococcus lactis, Lactobacillus planetarium, Acetobacter acetic, to produce kefir from pasteurized cow's milk, the kefir retained with sensory properties for more than 30 days when stored at room temperature.[89] . Kefir milk was also produced from the milk of cows and buffalo by using a combined culture of Streptococcus thermophilus and Lactobacillus bulgaricus. It was found that kefir produced from buffalo milk kept in higher numbers of bacteria and yeasts when stored at 4°C for 21 days [90].

S.boulardii was used to produce fruits-enriched yoghurt from cow's milk. The product kept in high numbers of live yeast 7 log CFU/g after storage at 4 ° C for 4 weeks [91].

Conclusion

Probiotics have proven their efficiency as one of the most important nutritional, preventive and therapeutic strategies through their possession of many mechanisms and incorporation into many diverse functional foods, especially fermented products, in order to meet consumers requirements for a health condition that must be met in the food consumed as a healthy point, and preference it over pharmaceutical forms in many aspects, which are dominated by dairy products, as it is one of the most important means of delivering probiotics to the human intestine and creating the desired health effect.

References

1- Cho I , Blaser M.J.The human microbiome :At the interface of health and disease .

Nat. Rev. Genet . 2012. Mar 13;13(4):260-70. doi: 10.1038/nrg3182.

2- Sarah C, Rachel M , Lauretta B, Brie P , Jennifer W& Randy T.The Human Microbiome: Composition and Change Reflecting Health and Disease. J of the Hum Anat and Phys Soc. 2019. Augest 19; 23(2) 432-445.

3- Maria G D, Filipa G , Rob K, Martin J B. Role of the micro biome in human development . Gut. 2019. Jun 68; (6):1108-1114. doi: 10.1136/gutjnl-2018-317503.

4- Guarner F, Malagelada,JR. Gut flora in health and disease. Lancet. 2003 Feb 8;361(9356):512-9. doi: 10.1016/S0140-6736(03)12489-0.

5- Puertollano E,Kolida S & Yaqoob P.(2014). Biological significance of short chain fatty acid metabolism by the intestinal microbiome. Curr Opin Clin Nutr Metab Care. 2014 . Mar;17(2):139-44. doi: 10.1097/MCO.0000000000000025..

6- Buckman SA, Heise CP. Nutrition considerations surrounding restorative proctocolectomy. Nutr Clin Pract .2010 Jun ;25(3):250-6. doi: 10.1177/0884533610368708.

7- Claus,S.P.,Ellero,S.L. & Berger,B. Colonization –induced host-gut microbial metabolic interaction. mBio . 2011 Mar 1;2(2):e00271-10. doi: 10.1128/mBio.00271-10.

8- Belkaid,Y. and H &,T.W. Role of the microbiota in immunity and inflammation . Cell .2014 Mar 27;157(1):121-41. doi: 10.1016/j.cell.2014.03.011.

9- Fariba MP,Yalda R S ,Abolfazl B,Mohammad DA & Sepidehz v . The impact of gut microbiota on kidney function and pathogenesis. Biomed Pharmacotherapy. 2017 Sep;93:412-419. doi: 10.1016/j.biopha.2017.06.066.

10- Musso G,Gambino R. & Cassader M .Obesity ,diabetes, and gut microbiota: the hygiene hypothesis expanded. Diabetes Care. 2010 Oct ;33(10):2277-84. doi: 10.2337/dc10-0556..

11- Lioyd-Price J, Abu-Ali, G . & Huttenhower C. The healthy human microbiome. Genome Med. 2016 Apr 27;8(1):51. doi: 10.1186/s13073-016-0307-y.

12- Stokholm J,Schjorring S. & EskildsenCE. Antibiotic use during pregnancy alters the commensal vaginal microbiota. Clin Microbiol Infect. 2014 Jul;20(7):629-35. doi: 10.1111/1469-0691.12411.

13- Grover,M.. Role of gut pathogens in development of irritable bowel syndrome. Indian J Med Res. 2014 Jan;139(1):11-8..

14- Ghoshal VC. & SrivastavaD..Irritabel bowel syndrome and small intestinal bacterial overgrowth the meaningful association or unnecessary hype. World J Gastroenterol.2014 Mar 14;20(10):2482-91. doi: 10.3748/wjg.v20.i10.2482.

15- Wang L, Conlon MA.,Christophersen CT,Sorich MJ & Angley MT. Gastrointestinal microbiota and metabolite biomarkers in Children with autism spectrum disorders. Biomark Me. 2014;8(3):331-44. doi: 10.2217/bmm.14.12.

16- Kang,Dw.,Park,JG. & IIhan,ZE. (2013).Reduced incidence of prevotella and otherfermenters in intestinal microflora of autistic Children. PLoS One. 2013 Jul 3;8(7):e68322. doi: 10.1371/journal.pone.0068322.

17- Swidsinki A ,Loening-Baucke V,Kruger M. & Kirsh Central nervous system and the colonic bioreactor: analysis of colonic microbiota in patients with stroke unravels unknown mechanisms of the host defense after brain injiury.Intest.Res.2012;10(4):332-347.

18- Nakao M ,Ogura Y.& Satake S:Use fullness of soluble dietary fiber for the treatment of diarrhea during enteral nutrition in elderly patients. Nutrition. 2002 Jan;18(1):35-9. doi: 10.1016/s0899-9007(01)00715-8.

19- O'Keefe,SJ.,Ou,J. & Delang,JP . (2011).Effect of fiber supplementation on the micro biota in critically ill patients. World J Gastrointestinal Pathophysiol. 2011 Dec15;2(6):138-45.
Doi10.4291/wjgp.v2.i6.138.
20-Swidsinki A ,Loening-Baucke V ,Kruger M. & Kirsh S. Central nervous system and the colonic bioreactor: analysis of colonic micro biota in patients with stroke unravels unknown mechanisms of the host defense after brain injiury.Intest.Res.2012.
10;(4):332-347.
21- Fernandes,J.,Su,W.,Raha-Rozenbloom S.,Woleuer,TM. & Comelli,EM . Adiposity
gut microbiota and faecal short chain fatty acids are inked in adult humans .Nutrition and Diabetes .,4:e121.
http://doi: 10.1038/nutd.2014.23.
22- Antoine,J.,M. (2010) .Probiotics: beneficial factors of the defense system. Proc Nutr Soc. 2010 Aug;69(3):429-33.
doi: 10.1017/S0029665110001692.
23- Gehloth B R & Ishnava KB. Evaluation of probiotic candidate in combination with
tuber extracts from corallocarpus epigaeus (ARN.) CL. For assessment of in vitro Alpha anylase inhibition activity. J. microbiol., biotechnol. food sci.2018. 98;(3):863- 866 .
24- Fooks,L.J. & Gibson,G.R.Probiotics as modulators of the gut flora. Br. J. Nutr.2002,88; 39-49.
http://doi: 10.1079/BJN2002628.
25- FAO & WHO. (200)1. Evaluation of health and nutritional properties of probiotic in food including powered milk life Lactic acid bacteria.Report of a Joint FAO/WHO Expert Consultation, Córdoba, Argentina Food and nutrition paper 85. Rome. Italy.
26- Aamir K ,Rami E , Alfred G and Justus K. (2009) . World
Gastroenterology Organization practice guideline: Probiotics and Prebiotics. Arab J Gastroenterol. 2009 Mar;10(1):33-42.
doi: 10.1016/j.ajg.2009.03.001..
27- Lee,Y.K.& Salminen,S. (2009).Handbook of probiotics and prebiotics .2nd edition . John Wiley and Sons, Inc.
28- Tukaszewicz,M. (2012).Saccharomyces cerevisiae var.boulardii probiotic yeast .
Intech open publisher .com
29- Gogineni VK ,Morrow LE. & Malesker MA.Probiotics :mechanisms of action and
clinical applications l., J Prob Health 2013, 1:1.1-11. DOI: 10.4172/2329-8901.1000101
30- Ozcan O ,Ozcan T,Yilmaz-Ersan,L,Akpiner-Arzu-B. & Delikanli B.The use of prebiotics of plant origin in functional milk products. Food Sci and Techno.
2016.4(2):15-22
doi: 10.13189/fst.2016.040201
31- Jasim M. S , Taha A. Y. 2017. Effect of supplementation of probiotic and citric
acid to laying hens diet on eggs quality traits. The Iraqi Journal of Agricultural Sciences.2017. 48(2) :985-952 .
32- Walker,A. (2014).Intestinal colonization and programming of the intestinal immune
response. J Clin Gastroenterol. Nov-Dec 2014;48 Suppl 1(2013):S8-11.
doi: 10.1097/MCG.0000000000000230.
33- Floch,M.H. (2014).Recommendations for probiotic use in humans – A 2014 Update. Pharmaceuticals (Basel). 2014 Oct 10;7(10):999-1007.
doi: 10.3390/ph7100999.
34- Nee-Skoci N K, Rzepkowska A , Szydłowska, A. & Koło Z D. (2018). Chapter 3-Trends and Possibilities of the Use of Probiotics in Food Production. In Alternative and Replacement Foods, Academic: Handbook of Food Bioengineering .65-94 .
35-S. Vijayaram & S. Kannan. Probiotics: The marvelous factor and health benefits. Biomed and Biotech Rese Jo.2018.2(1):1-8 36- Grover HS. & Luthra S. Probiotics-

the nano soldiers of oral health. J. Indian Acad. Clin. Med..2012.13;(1):48-54

37- Miller HJ,Gibson GR. & Bruck W .Some insights into the derivation and early uses of the word probiotic. Br J Nutr. 2003 Oct;90(4):845. doi: 10.1079/bjn2003954.

38-Mirzaei H, Pourjafar HM.& Homayouni A . Effect of calcium alginate and resistant

starch microencapsulation on the survival rate of Lactobacillus acidophilus Lab and Sensory properties in Iranian white brined cheese .Food Chemistry.2013.132:1966-1970.

39- Gasbarrini G., Bonvicini F & Gramenzi A. Probiotics History . J of Clinic

Gastroentero.2016. 50, S116-S119 .

40- Orrhage K ,Brismar R & Nord C E .Effect of supplements with Bifidobacterium langum and Lactobacillus acidophilus on the intestinal microbiota during Administration of clindamycin. Microbial Ecology in Health and Disease 1994.7;17-22.

41- Elisa KB. & Scott BS. Regulatory T-celsl in inflammatory bowel disease .

Opin Gastroenterol. 2008 Nov;24(6):733-41. doi: 10.1097/mog.0b013e328311f26e.

42- Prado FC, Parada JL, Pandey A, & Soccol CR .Trends in Non-dairy Probiotic Beverages. Food res inter. 2008. 41:111-123.

43- Snigdha M, Debapriya M. & Swati M. Applications of Probiotics as a Functional

Ingredient in Food and Gut Health . J of Food and Nut Res.2019. 7(3): 213-223.

44- Parvez S,Malik KA,KanyAH & Kim HY.Probiotics and their fermented food

Products are beneficial for health J Appl Microbiol. 2006 Jun;100(6):1171-85. doi:10.1111/j.1365-2672.2006.02963.x.

45- Saleh GM. Isolation and characterization of unique fructophilic lactic acid bacteria from different flower sources. Iraqi J of Agri Sci . 2020.51(2):508-518 .

46- Putta S , Yarla NS, Lakkappa DB, Imandi SB, Malla R R, Chaitanya, AK, Chari B P V, Saka S , Vechalapu RR & Kamal MA. (2018) . Probiotics Supplements,Food, Pharmaceutical Industry. In: Grumezescu A.M., Holban A.M.,. Therapeutic, Probiotic, and Unconventional Foods. Academic Press, UK and USA.

47- Weese JS. Evalution of deficiencies in labeling of commercial probiotics. Can Vet J. 2003 Dec;44(12):982-3.

48- Marcobal,A., Underwood,MA. & Mills,DA .Rapid determination of the bacterial composition of commercial probiotic products by terminal restriction fragment length polymorphism analysis. J Pediatr Gastroenterol Nutr. 2008 May;46(5):608-11.

doi: 10.1097/MPG.0b013e3181660694.

49- Masco L,Huys G.Brandet E ,Temmerman R. & Swings J. Culture-dependent and

culture-independent qualitative analysis of probiotic products . Int J Food Microbiol. 2005 Jul 15;102(2):221-30. doi: 10.1016/j.ijfoodmicro.2004.11.018.

50.Martins,F.S.,Nardi,R.M.,Arantes,R.M., Bosa,C.A.,Nefes,M.T. & Nicoli,J.R

Screening of yeasts as probiotic based on capacities to colonize the gastrointestinal

tract and to protect against enteropathogenic challenge in mice. J Gen Appl Microbiol. 2005 Apr;51(2):83-92.

doi: 10.2323/jgam.51.83.

51- Young E , Pei L T, Sei M L, Da H C & Seok M Y. Laxative effect of probiotic Chocolate on loperamide-induced constipation in rats. Food Res Int. 2019 Feb;116:1173-1182. doi: 10.1016/j.

52-Enore G C, Caruso D , Buonomo G,D'Avino M , Ciampaglia R, Maisto M,Schisano C,Bocchino B. & Novellino E. Lactofermented Annurca Apple Puree as a

Functional Food Indicated for the Control of Plasma Lipid and Oxidative Amine Levels: Results from a Randomised Clinical Trial. Nutrients. 2019 Jan 9;11(1):122.
doi: 10.3390/nu11010122.
53- Steinkraus von, K.H. 1983 .Handbook of indigenous fermented foods, Verlag . Marcel Decker,New York and Basel.
54- Granato D , Branco GF, Nazzaro F , Cruz AG & Faria JAF. Functional Foods and Nondairy Probiotic Food Development: Trends, Concepts, and Products. Compr Rev Food Sci Food Saf. 2010 May;9(3):292-302.
doi: 10.1111/j.1541-4337.2010.00110.x
55- Kumar B.V, Vijayendra S VN, & Reddy OVS. Trends in dairy and non-dairy probiotic products . J Food Sci Technol. 2015 Oct;52(10):6112-24.
doi: 10.1007/s13197-015-1795-2.
56- Özer BH & Kirmaci HA.Functional Milks and Dairy Beverages . Int. J. Dairy Technol.2010, 63:1-15.
57- Danfeng S , Salam I. & Saeed H. Recent Application of Probiotics in Food and Agricultural Science. Probiotics. Everlon Cid Rigobelo,2012. Intech Open.
58- Cerbo AD. & Palmieri B. The market of probiotics Pak J Pharm Sci. 2015 Nov;28(6):2199-206.
59- Deshpande H , Katke S, Sawate A. & Tamboli N. A review on global market and trends of probiotics. International Journal of Chemical Studies. 2019.7(4): 244-248.
60- Alessandro, D C & Beniamino P. The market of probiotics. Pak. J. Pharm. Sci.,2015. 28 (6): 2199-2206.
61- Zayat AI,Ahmed HA,El-Bakary AS & Osman M M.Using of Lactobacillus spp.isolates as bio preservative cultures in some dairy products Egg. J. Dairy Sci.2008.,36:13-30.
62- Rai R, Shangpliang H NJ , & Tamang J P. Naturally fermented milk products of the Eastern Himalayas. J. Ethn. Foods . 2016.3, 270-275.
63- Abdullah B and Tulay O. Growth of probiotic bacteria and characteristics of fermented milk containing fruit matrices. Int .J. Dairy Tech, .2018 .71:120-129.
64- Samah M & Hoda S. Production of UF-soft cheese using probiotics bacteria and Aloe vera pulp as a good source of nutrients. Ann. Agric. Sci. 2020. 65 (1): 13-20.
65-. Xanthopoulos V, Ipsilandis C G & Tzanetakis N.Use of a selected multi-strain potential probiotic culture for the manufacture of set-type yogurt from caprine milk. Small Rumin. Res..2012. 106, 145–153.
66- Salamoura C, Kontogianni A, Katsipi D, Kandylis P & Varzakas T Probiotic Fermented milks made of cow's milk, goat's milk and their mixture. J. Biotechnol. 2014;185, S77.
67- Mituniewicz-Małek, A., Ziarno, M., Dmytrow, I. & Balejko, J.Effect of the addition of Bifidobacterium monocultures on the physical, chemical, and sensory Characteristics of fermented goat milk. J Dairy Sci . 2017 Sep;100(9):6972-6979.
doi: 10.3168/jds.2017-12818
68-Tamires A D G M, Maria E G O, Maria I FC, Paloma Ol A A , Evandro L S, Marta SM, Maria TBP, Maria M E P & Ramos E Q .Impact of honey on quality characteristics of goat yogurt containing probiotic Lactobacillus acidophilus . LWT.2017. 80 , 221-229.
69- Kınık O, Kesenkas H , Ergon P G & Akan E. The effect of using pro and prebiotics on the aromatic compounds, textural and sensorial properties of symbiotic goat cheese. Mljekarstvo/ Dairy.2017. 67 : 71–85.
70-Dimitra D, Chrysoula S, Artemis K, Despoina K, Panagiotis K, George Z & Theodoros V. Effect of Milk Type on the Microbiological, Physicochemical and

Sensory Characteristics of Probiotic Fermented Milk. Microorganisms. 2019 Aug 21;7(9):274 .

71-Chaminda S R, Nenad N & Said A. Non-bovine milk products as emerging Probiotic carriers: recent developments and innovation. Curr Opin Food Sci. 2018, 22: 109-114.

72- Pawlos M, Znamirowska1 A, Kluz M, Szajnar K and Kowalczyk, M. Low – lactose fermented goat milks with Bifidobacterium animalis ssp. lactis BB-12. J .Microbio. Biotech and Food Sci. 2020 ;9(4):751-755.

73- Magdy M I, Mohamed N F & Esraa M. Using Goat's Milk, Barley Flour, Honey and Probiotic to Manufacture of Functional Dairy Product. Probiotics Antimicrob Proteins. 2018 Dec;10(4):677-691.
doi: 10.1007/s12602-017-9316-4.

74- Meira Q G S, Magnani M, de Medeiros Junior F C, Queiroga R C R. ´ E, Madruga M S , Gullon B & de Souza E L . Effects of ´ added Lactobacillus acidophilus and Bifidobacterium lactis probiotics on the quality characteristics of goat ricotta and their survival under simulated gastrointestinal conditions. Food Res Int. 2015 Oct;76(3):828-838.

75-Radulovic Z , Cinovic J M., Mirkovic, N, Mirkovic M, Paunovic D S. , Ivanovic M & Seratlic S. (2017). Survival of spray-dried and free-cells of ´ potential probiotic Lactobacillus plantarum 564 in soft goat cheese. Anim Sci J. 2017 Nov;88(11):1849-1854.
doi: 10.1111/asj.12802

76- Moraes G M D ,Santos K M O, Barcelos S C , Lopes S A & Egito A. S. Potentially probiotic goat cheese produced with autochthonous adjunct culture of Lactobacillus mucosae, microbiological, physicochemical and sensory attributes. LWT – Food Sci and Tech.2018. 94: 57–63.

77-Ranadheera C S , Evans C A, Adams M C & Baines S K. Co-culturing of probiotics Influences. The microbial and physico-chemical properties but not sensory quality of fermented dairy drink made from goats' milk. Small Rumin Res.2016. 136: 104–108.

78- Pinto J M S , Sousa S , Rodrigues D M, Malcata F X, Duarte A C, Rocha-Santos TA P & Gomes A M. Effect of probiotic co-cultures on physio-chemical and biochemical properties of small ruminants' fermented milk. Int Dairy J .2017. 72: 29–35 .

79- Silveira E O, Lopes Neto J H, Silva, L A , Raposo A E S, Magnani M & Cardarelli H R.The effects of inulin combined with oligofructose and goat cheese whey on the physicochemical properties and sensory acceptance of a probiotic chocolate goat dairy beverage. LWT - Food Sci and Technol.2015. 62: 445–451.

80- Silva P D L, Bezerra M F, Santos KM O & Correia R T P. Potentially probiotic ice cream from goat's milk: Characterization and cell viability during processing, storage and simulated gastrointestinal conditions. LWT - Food Sci and Technol.2015. 62, 452–457 .

81- Khaleel A , Thaer A. Using probiotics and inulin to prolong fermenting dairy Products shelf. The Iraqi J of Agri Sci.2017. (2) 48: 608-617.

82-Hye J, Jang Hyung-Seok Y, Na-Ky0ung L & Hyng H.Evaluation of the Quality of yogurt using ginseng extract powder and probiotic Lactobacillus plantarum NK 181 .Korean J for Food Sci of Anim Reso , 2018. 38;(6):1160-1167.

83-Ji,W., Tong W, Xiaobin F & Zhennai Y . Manufacture of low-fat cheddar cheese by Exopolysaccharide producing Lactobacillus plantarum JLK0142 and its

functional properties. J of Dairy Sci .2019, 102;(5): 3825-3838.

84- Lara-Hidalgo CE,Sanchez,Herandez H ,Rodriguez-Hernandez C & Dorantes-Alvares L.Yeast in fermented foods and their probiotic potential. Austin J of Nutri and Metabol.2017. 4(1):1045.

85- Guzel-Seydim ZR,Kok-Tas T ,Green Ak & Seydim AC. review: functional Properties of kefir. Critical Rev in Food Sci and Nutri. 2011, 51(3):261- 26849.

86- AltayF,Karbancioglu-Guler F,Daskaya-Dikmen C. & Hererkan. A review on traditional Turkish fermented non-alcoholic beverages:microbial fermentation Process and quality characteristics ..Inter J of Food micro .2013,167(1):44-56.

87- Oner Z ,Karahan A G and Cakmakei M L.Effects of different milk types and starter culture on kefir. GIDA .2010 . 35(3): 177-182.

88- Liu J R & Lin C W . Production of kefir from soymilk with or without added glucose, lactose or sucrose. J of Food Sci.2000. 65(4):716-719.

89- Motaghi M,Mazaheli M,Mozami N,Farkondeh A ,Fooladi MH. & Goltapeh EM.Short communication :kefir production in Iran. World J and Biotechno. 1997,13:579-581.

90- Gul O,. Mortas M, Atalar I, Dervisoglu M, & T. Kahyaoglu T . Manufacture and characterization of kefir made from cow and buffalo milk, using kefir grain and starter culture. J .Dairy Sci 2015. 98 :1517–1525.

91- Lourens-Hattingh & B.C .Viljoen B.C .Growth and survival of a yeast in dairy products. Food Res Inter.2001. 34(9):791-796.