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The non-dairy probiotic potential of the prebiotic Turkish snack "leblebi"

Fatih ÖZBEY[1]*

Abstract

Today, there are hundreds of different diets recommended around the world for healthy nutrition from the "Karatay diet" to the "Stone Age diet" or "Paleo diet". Almost none of these diets prohibit the consumption of legumes. In fact, physicians have also recommended eating a small amount of chickpeas regularly in order to reduce stomach acidity. Chickpeas also have a distinct place in the vegetarian diet due to the nutritional components they contain. Leblebi stands out as a healthy and tasty traditional product that can be consumed at any time of the day. Although chickpeas contains 30% starch, the glycaemic index of leblebi is low (20-30), indicating that it will not suddenly increase the blood glucose level. The aim of this review is to provide an overview of probiotic opportunities for new product development and nutrition research of the traditional chickpea product of Turkey known as leblebi.

Keywords: non-dairy functional foods; probiotics; snack food; legumes; leblebi.

Practical Application: Producing non-dairy probiotic roasted chickpea.

1 Introduction

Healthy nutrition is essential for the protection and development of health and the prevention of chronic diseases in every period of life. In today's world of information pollution about nutrition, the knowledge and application of adequate and balanced nutrition information by every individual is critical in terms of community health. The most important societal problem today is obesity, which is the result of eating habits that are changing in the direction of changing living conditions. Obesity can be defined as the accumulation of fat on the body that disturbs health or the amount of fat in the body above normal proportions. According to research, more than 1 billion individuals were considered obese, and 2.5 billion individuals slightly obese in 2017 (Food and Agricultural Organization of the United Nations, 2017). Studies have suggested that intensive energy-based eating habits are an important factor in the emergence of many diseases. For example, obesity is the most important underlying cause of 44% of all cases of diabetes worldwide, 23% of heart disease, and 7- 41% of some cancer types. The basic condition for preventing obesity is adequate and balanced nutrition. The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) jointly declared in 2003 that dietary energy, total fat, trans fatty acids, sugar and salt should be reduced to avoid significant community health problems. One of the most important problems encountered in the 21st century is the ever-increasing human population resulting in a competition for resources. A natural consequence of this is than an, estimated 1 out of every 9 people in the world is malnourished due to lack of protein-energy (Torres-Tiji et al., 2020).

The "fast food" diet, which emerges as a result of the high tempos of daily work, has become pervasive in all areas of the globe. Products known as snack foods and candies that can be consumed at any time of day are important components of this type of diet. Carbohydrate structures in the composition of foods increase the body's blood sugar levels after consumption, at different rates. The glycaemic index (GI) is used to describe and measure the metabolizing function of carbohydrates in our bodies. The glycaemic index is a method of relatively grading how much of the normal blood glucose level is obtained when foods containing 50 grams of carbohydrates are consumed alone. Healthy individuals need to reduce glycaemic load in their diet. For this purpose, the consumption of foods such as legumes, whole grain, cookies, non-starchy fruits should be increased, potatoes, rice, white bread, sugary drinks, cakes and so on should be decreased and more attention should be paid to the consumption of high glycaemic index foods such as products.

One of the traditional tastes of the Ottoman-Turkish food culture is leblebi or roasted chickpeas. Chickpeas, the raw material for leblebi, contain protein, carbohydrates, and minerals and are an economic and healthy option easily available for every budget. Many chickpea varieties are grown in Turkey and the majority of them are used for human consumption. Approximately 20% of these varieties are used in the production of leblebi.

The aim of this review is to provide an overview of probiotic opportunities for new product development and nutrition research of the traditional chickpea product of Turkey known as leblebi.

2 Leblebi production steps

The word "leblebi" is derived from the Persian word "leblebû", meaning roasted chickpeas. It is reported that leblebi was produced firstly in Anatolia in the 17th century. There is no exact information about who the first producers were, but the names Ahmedi Sever and Sheik Murat Gazi can be

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[1] *Department of Nutrition and Dietetics, Faculty of Hamidiye Health Sciences, University of Health Sciences Turkey, İstanbul, Turkey*
*Corresponding author: fatih.ozbey@sbu.edu.tr

found in the literature. There are similar chickpea products in different parts of the world known by different names such as Bengal gram (India), Roasted Chickpea (English), Garbanzo (Latin America), Hommes, Hamaz (Middle East), and Shimbra (Ethiopia). In addition, leblebi is produced in Greece and Iran and is known, by the name "leblebija" in Balkan countries (Kosovo, Macedonia, Bosnia and Herzegovina) where Turkish populations can be found. Although leblebi has been produced consumed in Turkey since the time of the Ottoman Empire to the present day, studies on the history, origin, traditional production stages, composition, nutritional value, and quality are limited. Yellow and white (Sakız) leblebi are two important kinds of traditionally produced roasted chickpeas in Turkey (Özbey, 2017; Coşkuner & Karababa, 2004). The leblebi production process consists of two basic steps heating and resting. The processes applied in production differ according to the physical characteristics of the chickpeas and the experience of the craftsman. (Özbey, 2017; Özbey & Görgülü, 2016; Aydın, 2002; Bilgir, 1976; Gençkan, 1958; Gülümser, 1988).

Chickpeas are subjected to sorting and any foreign substances are removed in the first step of production. This process is long and troublesome but critical for the success of the subsequent production steps (Figure 1). The selected chickpeas must be around 55-57 gr. For this purpose, chickpeas are classified according to their size by using 9-mesh sieves and grouped to prepare a homogenous roasting. The grouped chickpeas are then soaked and following that, are roasted in wood-burning furnaces made of firebrick that have a piece of 90-110 cm indented copper in the middle. The roasting process begins by heating the furnaces with oak wood and continues until such time that the craftsman deems the chickpeas sufficiently roasted. After roasting, the chickpeas are put into burlap sacks and rested for one day. After the resting process, the chickpeas are checked, reclassified, then soaked for the second roasting, and finally roasted again. The roasting process lasts between 12 minutes and 25 minutes depending on the moisture content of the chickpeas. The chickpeas are rested once again in burlap sacks, then spread on the ground and rested for one week. They are classified and soaked for roasting a third time. The third roasting is the shortest at approximately 10 minutes. They are once again rested in burlap sacks. The chickpeas should be stirred frequently during resting. The final resting period can last from 30 to 45 days -the longer the rest period, the more flavourful the resulting leblebi will be. Once deemed ready, leblebi are fried and then are ready for consumption (Özbey, 2018). The full production process is usually carried out from beginning to end by the sane craftsman as it requires a high level of skill and experience. Leblebi can be flavoured using red pepper, cloves, or simply salt.

3 Health benefits of leblebi

Chickpeas (*Cicer arietinum L.*) are an important agricultural product that have been cultivated since ancient times. Chickpeas are cultivated throughout the Southeast region of Turkey, with some archaeological research suggesting they have been grown there for over 7000 years. According to the Food and Agricultural Organization of the United Nations, the chickpea is globally ranked 4th in terms of planting area and 5th in terms

Figure 1. Traditional Turkish leblebi production steps (Özbey, 2018).

of production. Chickpea are important sources of minerals (Ca, Zn, Mg, K, Fe, P) and vitamins (thiamin and niacin) and have two types: microsperma or desi and macrosperma or kabuli. Microsperma are typically cultivated in India, Pakistan and East Africa, while the macrosperma chickpea is generally cultivated in Mediterranean countries, North America, and the Far East (Özer et al., 2010).

One of the most important sources of protein and calories after cereals in terms of the global diet is legumes. The chickpea is the first among the legumes. The largest producer of chickpea in the world is India with 65% of global production, followed by Australia with 14%, while Turkey accounts for about 4% of global production. Chickpeas are grown in every region of Turkey and the cultvar as well as cultivation varies by region (Merga & Haji, 2019).

In the 2015-2020 Dietary Guidelines for Americans (DGA) dark green vegetables, red and orange vegetables, and legumes are recommended as healthy options (Wallace et al., 2016). Legumes are mature seeds of the Leguminaseae family of plants. Dry beans such as: chickpeas, beans, peas, soya beans, lentils, and cowpeas are the most consumed legumes. Because they are mature seeds, their basic composition is carbohydrate and protein. The outer part of the grains consists of fibre while the inner area is starch. Legumes have a low-fat content and are composed mainly of polyunsaturated fatty acids with high protein ratios. Because air can accumulate nitrogen in their roots, legumes are enriched with nitrogen. Overall legumes are a healthy and economical source of vegetable protein, especially when animal protein sources are insufficient or fat and cholesterol-restricted diets are suggested. Today, there are hundreds of different diets recommended around the world for healthy nutrition from the "Karatay diet" to the "Stone Age diet" or "Paleo diet". Almost none of these diets prohibit the consumption of legumes. In fact, physicians have also recommended eating a small amount of chickpeas regularly in order to reduce stomach acidity. Chickpeas also have a distinct place in the vegetarian diet due to the nutritional components they contain.

Fast foods create higher blood glucose levels than healthier food and also create faster than normal digestion due to their high GI values. Typically, foods with high GI values cause the amount of insulin in the blood to rise and fall more quickly, so people tend to feel hungry sooner than if they had eaten a healthier option. The lower the GI value of the consumed foods, the longer the feeling of satiety. Research has shown that people who consume "fast food" have an accelerated development of insulin resistance in the liver, may encounter diabetes (diabetes mellitus) at earlier ages, and may have an increased risk of cardiovascular diseases and various cancer types at earlier ages. A common view of many nutritionists is that consumption of foods containing some high-quality protein, fibre, and complex carbohydrates with a low glycaemic index every single day is necessary for healthy eating habits. Leblebi stands out as a healthy and tasty traditional product that can be consumed at any time of the day. Although chickpeas contains 30% starch, the glycaemic index of leblebi is low (20-30), indicating that it will not suddenly increase the blood glucose level. Additionally, a 100g serving of leblebi provides 98% of the daily recommended intake of iron, 70% of phosphorus and selenium, 61% of fibre and 40% of protein (TürKomp, 2014; Özbey, 2017, 2018; Özbey & Görgülü, 2016). As health problems continue to arise because of poor nutrition habits, it may be necessary to reintroduce leblebi as a healthy snack alternative both in Turkey and around the world.

Despite the best efforts of governments and healthcare professionals' obesity continues to increase in the world (Brand-Miller et al., 2002). Type II diabetes mellitus, which represents at least 90% of all diagnosed cases of diabetes, is one of the major diseases commonly associated with obesity. If measures are not taken to reduce obesity, it is predicted that diabetes, which is the fourth of the five causes of death in the world, will increase. There are bioactive components in the composition of chickpeas that have many effects controlling obesity and type II diabetes (Camargo et al., 2019; Njume et al., 2019).

Macro food components have an important role in human health and nutrition. The proximate composition of chickpeas can be seen in Table 1. Besides being a rich source of carbohydrates, protein, fibres, minerals, and vitamins, chickpeas also contain bioactive substances. Giron-Calle's research determined the effects of the cell growth-regulating properties of chickpea seed extract on anti-cancer factors and concluded that the chickpea extracts inhibited the development of the cancerous Caco-2 phenotype of cells. The effects of biochanin A on the mammary carcinoma cell line MCF-7 cell growth has also been reported (Camargo et al., 2019). It has been stated in many studies conducted in this area that chickpea consumption reduces the risk of chronic diseases and has positive effects on health (Duranti, 2006; Girón-Calle et al., 2004; Murty et al., 2010; Nestel et al., 2004; Pittaway et al., 2008; Wood & Grusak, 2007; Yang et al., 2007). In addition, chickpea consumption is reported to have health benefits as a functional food. For example, it has been stated that it is beneficial in terms of reducing cardiovascular risk due to its richness in dietary fibre, β-carotene, and low glycemic index (Crujeiras et al., 2007; Duranti, 2006; Hu et al., 2001). Studies conducted on obese individuals have reported that a diet high in chickpea-based dietary fibre has a lowering effect on total plasma cholesterol (Crujeiras et al., 2007), and in another study intake linoleic acid, which is the dominant fatty acid in chickpeas, has positive effects on serum lipids and insulin sensitivity (Bar-El Dadon et al., 2017; Hu et al., 2001; Sanders et al., 1997).

The health benefits of carbohydrates in chickpea composition continue to increase its popularity around the world. Prebiotic carbohydrates are fermented by the intestinal microbiota and contribute positively to human health. By reducing cholesterol absorption, inflammation, blood pressure, and nutrient absorption, they lower the intestinal pH and thus make a positive contribution to human health (Siva et al., 2020). Non-starch carbohydrates, that can be found in the structure of plant foods concentrated in the shell parts of plants and are not digested in human metabolism when these grains are consumed, are called fibre. Fibre that is naturally present in consumed foods is called dietary fibre. The best sources for dietary fibre, which has an important role in long-lasting feelings of satiety and regular functioning of the intestines, are fresh vegetables and fruits, whole-grain products, and legumes. Ingesting the fibre,

naturally contained within foods is necessary to properly fulfil these functions, meaning that supplemental fibre derivatives are not as beneficial. Consuming dietary fibre is of special importance for the elderly, because of its protective and therapeutic effects. There are also positive effects in reducing the risk of colon cancer by preventing constipation seen in advanced ages. For these effects to be adequately achieved, it is necessary to increase the consumption of legumes elderly individuals.

The steps used in the leblebi production causes some changes in cellulose, acid detergent fibre (ADF), and neutral detergent fibre (NDF) (Figure 2). The change in the total phenolic content (TPC) and total antioxidant capacity of chickpeas in leblebi production steps are shown in Figures 3 and 4. In addition, new antioxidants and phenolics are formed due to the Maillard reaction, increasing the TPC and total antioxidant capacity at the roasting steps. Leblebi processing results in considerable losses of carbohydrates, ash, and dietary fibre mainly since the outer portions of the chickpeas which contains cotyledon constituents, are removed during the dehulling portion of the roasting steps. As a result of changes in the microstructure of the chickpea after leblebi production, there are also changes in its chemical composition. As well, the essential amino acids, oleic acids, and linoleic acids are not negatively affected by the roasting process. Studies show that traditional production stages for leblebi not only transform chickpeas into a consumable form, but also improve their nutritional properties (Simsek et al., 2016; Özbey, 2017).

In addition to their benefits in developing countries, chickpea-based products are an alternative to soy-based foods in developed countries. Since soy is considered to be a genetically modified product in European countries, it is increasingly being questioned (Bøhn et al., 2014). As well, being among the eight most allergenic foods in the world, extensive research has been done in this area. Another important problem is the discussion of the consequences of long-term consumption of soy-based products that may lead to unwanted improvements in sexual and reproductive development, immune functions, visual activity, and thyroid functions (Ito, 2015; Bar-El Dadon & Reifen, 2010). Due to these above-mentioned reasons, soy will eventually be replaced with chickpeas. Therefore, in the upcoming period, due to their nutritional properties chickpeas will likely be used in the production of many beverages and snacks with high protein content that can replace meat and dairy product in the food industry. These foods will no doubt be preferable as they are acceptable in terms of texture and taste, as they are suitable for a vegan diet with a balanced nutritional profile, they are gluten free, and have not been genetically modified.

Celiac disease, which is prevalent in approximately 1% of the global population, is an illness in which the small intestine is

Table 1. Effect of leblebi processing on chemical composition of chickpeas* (%).

Sample	Moisture	Protein	Fat	Ash	Carbohydrate
Raw chickpea	10.78d	19.11a	5.98a,b	2.54a,b	61.59a
1. Tempering	7.25c	19.44a	6.39b,c	2.60a,b	64.32b,c
2. Tempering	3.05a	20.44a	6.85b,c	2.77b	66.89d,e
Roasting	5.38b	20.51a	7.90d	2.46a	63.75b
Last Roasting (Dehulled leblebi)	3.31a	20.79a	7.85d	2.49a	62.13a,b

*Values are means of duplicate analysis. Means in the same column with different letters are significantly ($p<0.05$) different (Özbey, 2017).

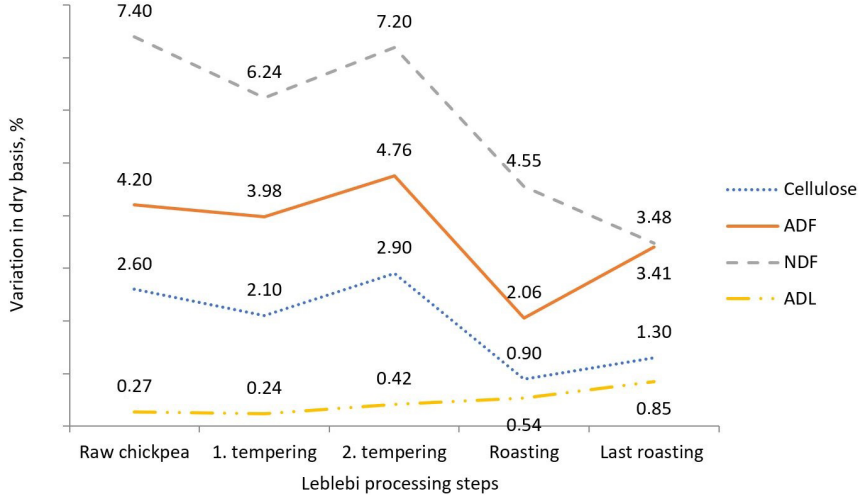

Figure 2. Effect of leblebi processing on dietary fibers content of chickpeas, %, dry basis (neutral detergent fibre – NDF, acid detergent fibre – ADF, and acid detergent lignin – ADL) (Özbey, 2017).

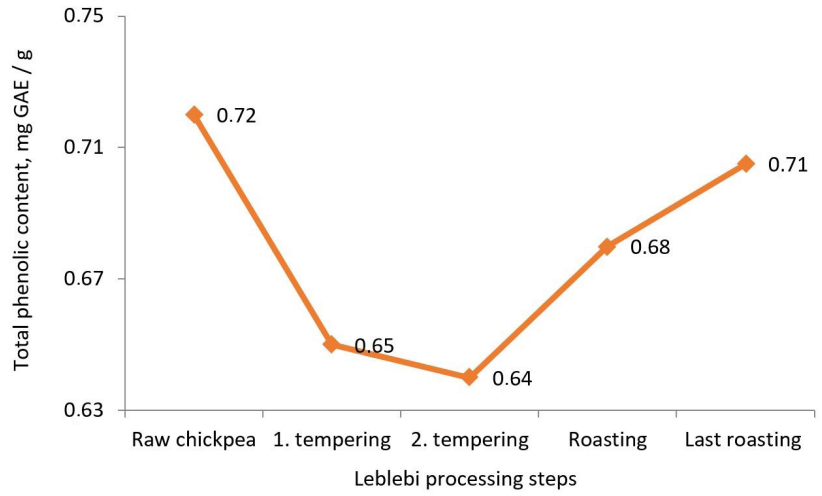

Figure 3. Effect of leblebi processing on total phenolic content of chickpeas, %, dry basis (Özbey, 2017).

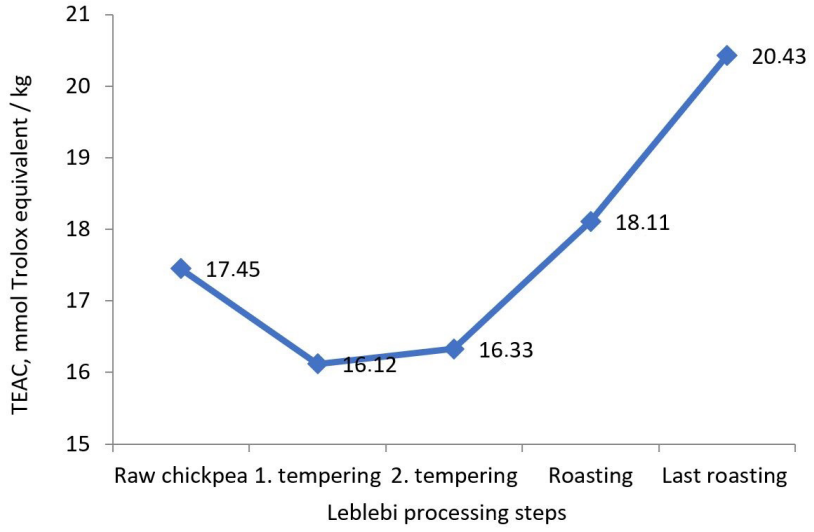

Figure 4. Effect of leblebi processing on total antioxidant capacity of chickpeas, %, dry basis (Özbey, 2017).

damaged, preventing the absorption of certain nutrients. The most effective treatment for this disease is a gluten-free diet. However, this type of diet can be a challenging to adapt to in part because of difficulties to access gluten-free foods, the costs associated with these types of foods, and the social and personal strains that can occur when following such a restrictive diet. Chickpeas, and by default leblebi, are an important nutritional source for individuals with celiac disease in terms of their availability and acceptable taste. It is important to ensure consumption of alternative grains with high nutritional properties, vegetables, fruit, and legumes rich in fibre and composition, to prevent possible deficiencies associated with the gluten-free diet. The difficulties in compliance to a gluten-free diet have led to the need for alternative treatment options for celiac disease. Although gluten proteins are the main environ-mental factors at the pathogenesis of the disease, recent studies have indicated that microbiota maybe also be involved as differences in microbiota compositions between patients diagnosed with celiac disease and healthy individuals indicate the effect of microbiota in the onset of the disease. It has been suggested that gut microbiota is associated with persistent symptoms in celiac disease, and administration of probiotics and/or prebiotics maybe beneficial in its treatment (Erdem & Açıkgöz, 2019; Ulusoy & Rakıcıoğlu, 2019; Özkaya & Özkaya, 2018). The potential use of probiotics in the maintenance of intestinal barrier function and regulation of the innate and adaptive immune system in celiac treatment is supported by disease-related dysbiosis (Erdem & Açıkgöz, 2019). Changes in intestinal microbiota, which are thought to be one of the environmental factors affecting the formation of celiac disease, may have a preventive effect in individuals with disease risk, with the use of probiotics and prebiotics.

The importance of vegan or vegetarian-based diets has increased as the desire to protect the ecological balance and

animal rights gain importance. As the percentage of people following these types of diets increases, chickpeas again become more important in terms of the need for a balanced diet with high fibre content, low fat, and cholesterol levels. Lacto-ovo and semi-vegetarian diet followers are permitted to consume dairy products, but vegans, ovo, and lacto vegetarians are not. Thus, the need for plant-based dairy products has increased rapidly. Producing probiotic products from prebiotic herbal sources for vegans and vegetarians has enabled the creation of nutritious and health-effective symbiotic products. The consumption of probiotic products by vegans and vegetarians increases the production of immunoglobulin and calcium absorption and provides the development of a more resistant immune system (Erk et al., 2019).

4 Probiotic leblebi

Probiotic food consumption is increasing day by day due to consumers' concerns about healthy eating and health in general. Reasons such as lactose intolerance, allergies to milk proteins, and dietary restrictions such as veganism, have increased, interest in non-dairy probiotic products (Bambace et al., 2019). Probiotics are living organisms that have a health effect when ingested in sufficient quantities and probiotic products are now widely accepted and demanded by consumers due to positive contributions they provide to overall health and their preventive effect from diseases. These products are rapidly growing component of functional foods (Bansal et al., 2016; Senok et al., 2005; Food and Agricultural Organization of the United Nations, 2002). The International Scientific Association for Probiotics and Prebiotics (ISAPP) added new definition for probiotics, which was put forward as a result of expert panel in 2013 -"live microorganisms which when administered in adequate amounts confer a health benefit on the host"- This new definition has been helpful for clinicians and consumers in the differentiating and understanding of probiotic products produced on the market. According to this definition, pricing of metabolites of probiotic microorganisms is accepted as probiotic as well as viability. The panel recommends that the term probiotic be used only on products that deliver live microorganisms with a suitable viable count of well-defined strains with a reasonable expectation of delivering benefits for the wellbeing of the host (Table 2). Morever, during recent years, new definitions are added to the probiotic terminology such as 'paraprobiotics' (dead/inactive cells of probiotics) and 'postbiotics' (healthful metabolites of probiotics), because findings have shown that dead cells (intact or ruptured) could also show significant health impacts on human. So, the restriction of "viability" in all probiotic definitions must be modified (Zendeboodi et al., 2020; Gibson et al. 2017; Hill et al., 2014).

Chickpeas have therefore become a more appreciated and more widely analysed plant as their healty prebiotic and probiotic compounds become more widely known. Consumers today are more conscious and anxious about their lifestyle than ever before so functional foods attract consumer interest worldwide. Therefore, the demand for functional products containing probiotic microorganisms that support health and wellness has increased. The increase in studies on functional foods has turned consumer attention from traditional foods to functional foods with more nutritious and health-effective properties. Although fermented dairy products are suitable substrates for probiotic microorganisms, consumers are in search of new alternatives due to the substantial number of lactose intolerant individuals, the high fat and cholesterol content of most dairy products and increasing vegetarianism. Although probiotics are predominantly based on milk matrices, non-dairy probiotic foods are slowly emerging as a valuable addition to the functional foods market. Therefore, researchers have been examining the feasibility of probiotic bacteria in non-dairy products such as legumes, and cereals. Several techniques that have been applied to maintain maximum levels of live probiotics are microencapsulation, edible films and coatings, and the use of sporulating probiotic microorganisms. There are various definitions of microencapsulation technology, however, it is mainly defined as the capture or protection of sensitive components in liquid, solid or gas phase by completely wrapping them with a protective matrix (Prisco & Mauriello, 2016; Anal & Singh, 2007; Sohail et al., 2011).

The functional food market is constantly growing in the developed world, and yoghurts are rapidly gaining space as they provide ideal vehicles to deliver bioactive nutrients to humans. One of the study results demonstrated that Pistacia extracts promoted the survival of lactic acid bacteria and NMR((Nuclear Magnetic Resonance) spectra additionally revealed that the functional fatty acids can be retained during the shelf life of yoghurts, alongside with the other bioactive compounds (Hadjimbei et al., 2020; Lucatto et al., 2020). Other study on the use of fruit and vegetable extracts in yoghurt have determined that gum arabic, pectin and black carrot puree supplementation had potential prebiotic on L. acidophilus and B. animalis subsp. lactis species, thus enhancing the technological properties and increasing the bio-functional properties of yoghurt (Karaman & Özcan, 2021).

A recent clinical study involving healthy individuals documented that probiotic Prato cheese helps reduce postprandial glycaemia (Grom et al., 2020). Lactobacillus strains may modulate gut-bone dysbiosis and/or produce bioactives associated with putative osteoprotective properties (Chen et al., 2017). According to Eor findings showed that the gut-bone axis can be modulated not only by viable Lactobacillus strains but also by milk products, which may contain metabolites and/or bioactive peptides (Eor et al., 2020).

Osteoporosis, a major skeletal disease associated with ageing According to the study findings demonstrated that the osteogenic effects of L. plantarum B719 fermented milk products in mouse pre-osteoblastic MC3T3-E1 cells. Because of the high content of bioavailable calcium milk product have been considered as important food supplements for bone health (Lee et al., 2020).

Probiotic dairy drink production was carried out by combining *Propionibacterium shermanii* subsp. *freudenreichii* with different probiotic bacteria. According to Yerlikaya result was also supported by the microbiological counts, and the results showed that there were no adverse effects on the product characteristics in samples containing *P. freudenreichii* (Yerlikaya et al., 2020)

Table 2. Categories of live microorganisms for human use as defined by the expert panel.

Description	Claim	Criteria*	Minimum level of evidence required to make claim	Comments
		Not probiotic		
Live or active cultures	"Contains live and active cultures"	Any food fermentation microbe(s)	No product-specific efficacy studies needed	The terms 'live' or 'active' do not imply probiotic activity
		Proof of viability at a minimum level reflective of typical levels seen in fermented foods, suggested to be 1 × 109 CFU per serving73		Fermented foods containing live cultures might also qualify as a 'probiotic' if they meet the criteria for that category (e.g. evidence that yogurt can improve lactose digestion in lactose maldigesters would qualify it as a 'probiotic'74,75)
		Probiotic		
Probiotic in food or supplement without health claim	"Contains probiotics"	A member(s) of a safe76,77 species, which is supported by sufficient evidence of a general beneficial effect in humans OR a safe microbe(s) with a property (e.g. a structure, activity or end product) for which there is sufficient evidence for a general beneficial effect in humans	Well-conducted human studies (e.g. these could involve RCT(s), observational studies, systematic reviews or meta-analyses supporting the observed general beneficial effect for the taxonomical category concerned)	Extrapolation of evidence must be based on reasonable expectations that the strain(s) incorporated in the product would have similar general beneficial effects in humans
		Proof of viability at the appropriate level used in supporting human studies73	The evidence does not have to be generated for the specific strain included in the product	This evidence could be based on taxonomical or functional comparisons
Probiotic in food or supplement with a specific health claim	Specific health claim, such as "helps to reinforce the body's natural defences in children" or "helps reduce the risk of antibiotic-associated diarrhoea"	Defined probiotic strain(s)	Convincing evidence needed for specific strain(s) or strain combination in the specified health indication	Well-designed observational studies are useful to detect the effect of foods on health in 'real life', that is, outside the controlled environment of an RCT (e.g. data on health benefits by dietary fibre are mostly observational)
		Proof of delivery of viable strain(s) at efficacious dose at end of shelf-life73	Such evidence includes well-conducted studies in humans, including: positive meta-analyses on specific strain(s) or strain combinations, as per principles outlined by Cochrane,78 PASSCLAIM,79 or GRADE;80 well-conducted RCT(s) OR strong evidence from large observational studies81	Sample sizes must be large enough to manage confounding factors
Probiotic drug	Specific indication for treatment or prevention of disease, such as "useful for the prevention of relapse of ulcerative colitis"	A defined strain(s) of live microbe	Appropriate trials to meet regulatory standards for drugs	What constitutes a drug claim varies among countries
		Proof of delivery of viable probiotic at efficacious dose at end of shelf-life		
		Risk-benefit assessment justifies use		

*Unless otherwise indicated, all criteria indicated must be met. Abbreviations: CFU = colony forming unit; GRADE = Grades of Recommendation Assessment, Development and Evaluation; PASSCLAIM = Process for the Assessment of Scientific Support for Claims on Food; RCT = randomized controlled trial (Hill et al., 2014).

In recent years popularity of probiotic enriched plant-based milk products are increased. Because of suitability of probiotics and have many health-related benefits plant-based milk substitutes is a new trend for consumers who are suffering from dairy related gastrointestinal disorder such as milk protein allergy or lactose intolerance, or simply want to have a vegan lifestyle (Rasika et al., 2021).

Legumes, consumed in most of the world, are ideal matrices to produce new probiotic foods because they contain high levels of vitamins, minerals, salt, dietary fibre, and antioxidants and do not contain microorganisms to compete with starter cultures. Due to their natural prebiotics, chickpeas are also ideal as a carriers for probiotic cultures from adverse condition of the gastrointestinal system. Also, chickpeas can be used to encapsulate probiotic microorganisms to preserve their vitality and functionality. The microencapsulation method is believed to allow for the increase in the passage of more probiotic organisms into the intestine by protecting them from the acidic conditions of gastrointestinal transit. The neutral pH values of probiotic leblebi (pH 6.8-6.5) represent an appropriate condition for L. paracasei survival during storage because of being a neutral raw material.

5 Conclusions

Due to the various difficulties of some developing countries in using fermented dairy products the use of alternative raw materials for probiotic agents is supported. Meat products, cereals, legumes, fruits, and vegetables are potential raw materials for healthy probiotics nutritional options.

Leblebi, in terms of its nutritional properties, is a healthy snack compared to its industrial sugar competitors, thanks to its high protein content, dietary fibre and mineral content, and the fact that it is low fat and sugar-free. It is also considered healthy due to its low glycaemic index and the fact that it is a whole grain that is not milled. Therefore leblebi, an economical and nutritious snack, can also be a suitable raw material for probiotic production.

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