

## Plant based fermented yogurt: an emerging segment of functional food products.

<sup>1</sup>Padmakshi Singh, <sup>2</sup> Nitika Rathi

<sup>1</sup>Student, <sup>2</sup>Assistant Professor

<sup>1</sup>Department of Food Technology,

<sup>1</sup>Uttaranchal University. Arcadia grant, Chandanwari, Premnagar, Dehradun, Uttarakhand, India

Email – <sup>1</sup>padmakshisingh05@gmail.com, <sup>2</sup>nitikarathi394@gmail.com

**Abstract:** Non-dairy or plant-based fermented milk products are developed from water extracts of plants, (or milk analogues) of seeds and nuts and have become a rapidly growing segment in the category of new food product development as functional or specialty food all over the world. In contrast with the past, today we see an increasing consumer demand for plant-based alternatives due to various reasons related to sustainability, health, lifestyle and dietary purposes. Lactose intolerance, allergies related to animal-based milk is another reason that has influenced people to show inclined interest toward non-dairy milk products. This has resulted in the emergence or development of new products that are based on nuts, seeds or beans. Additionally plant-based alternatives reflect an increasing scope to serve as an inexpensive alternate for those belonging to the low income group and in places where there is lack or insufficiency of cow milk or any other dairy based milk. Although there has been continuous efforts to enhance the overall characteristic of such plant-based milk product so as to make them more nutritive but certainly due to some technological issues like processing and preservation a majority of them result in being nutritionally inadequate compared to bovine milk. The nutritional properties depend on the source of the plant, processing technology and fortification. However such plant-based products do contain functionally active compounds that provide certain health benefits. Novel emerging technologies such as Ultra high temperature treatment, pulsed electric field are being studied for effectively overcoming the problems related to sensory acceptability, nutritional adequacy and shelf life of the final product. Collective endeavors focusing on the research and development of such food products are required to work out products that meet the consumer's needs in all aspects.

**Key Words:** plant-based alternatives, animal-based milk, fortification, fermented milk products.

### 1. INTRODUCTION:

The changing needs and demands of consumers have led to significant research accentuation in all areas of food product development as a result of which the researchers have come up with newer alternatives of health foods. The era of ever expanding urbanization has expedited these demands. An increase in consumer awareness regarding the impacts of food production and consumption on the environment and health play a major contributing factor to a decreased demand for animal-derived food products in developed countries. As a result of this the focus of food producers and researchers has shifted to address the current consumer demands and environmental concerns by formulating healthy and sustainable alternatives. The plant based milk substitutes are derived from water extracts of legumes, oil seeds, cereals or pseudo cereals that bear a resemblance to cow's milk in appearance. Such plant-based milk alternatives have been taken in use for the past many years. These substitutes are intended to resemble animal milk, which is an emulsion containing nutrients like lipids, proteins, amino acids, vitamins and minerals and that are produced by lactating mammals in order to give sufficient nourishment to their young ones for their growth and development. Although due to lack of proper processing technologies they fail to provide the full nutritional value as cow milk and bear undesirable sensory characteristics (1). Due to this the products made commercially are consistently altered by using additives such as protein, vitamins and minerals. In contrast to this situation the top manufacturers are making continuous efforts in order to remove the artificial ingredients from their products. The customers expect the food to be clean label which means having no additives and it has now also become a rapidly growing trend. With this naturally procured plant-based milk alternative, which are similar to animal-based milk in terms of nutritional quality and taste are preferably of more interest.

In order to reach this goal, fermentation may be the most suitable option. Since a very long time, fermentation has been adopted to produce a variety of foods and fermented foods are now more popular than they were ever before. Plant-based yogurts serve as an imperative segment among the dairy-free alternatives, addressing the requirements of many consumers, for example those with lactose intolerance, allergies and moral concerns. In comparison to 2015, the number of new product developments in the category of plant based yoghurt was about 20 percent higher in 2016.

Fermented aqueous extracts obtained from various raw materials like some legumes, oil seeds, cereals and pseudo-cereals are principally used to make plant-based yoghurts. These extracts have similar appearance and consistency similar to that of cow milk or other animal-based milk which is a result of sufficient breakdown and homogenization of materials. Fermentation (natural/controlled) stimulates the activity of bioactive compounds. In addition to this the incorporation of some valuable and nutritionally consequential components magnify the overall quality of the product by chiefly augmenting quality of protein, mineral bioavailability along with some other essential elements (2). Most commonly legumes, cereals and oilseeds are chosen to produce different milk substitute, this is due to their rich nutritional profile. The milk quality is often enhanced with specific bioactive components when compared with milk of animal origin. It has been seen that during production of fermented food products like bread, coffee, chocolate, wine, cheese, pickles, kimchi and sauerkraut, the nutritional value, aroma and taste, texture and stability is often improved by food grade microbes which in turns contribute to the shelf life and microbial safety of such products. To be specific, the application and use of monoculture fermentation to foods is well recognized (1). Recent developments indicate the design of mixed culture fermentation which is done more than two microorganisms that occurs naturally in various food production processes and is also becoming more and more salient (3). This has emerged as an encouraging means for plant-based milk fermentation because of the probable synergistic consequences that helps to ameliorate varied quality criteria with only a single process (1). Plant materials such as cereal, legumes, pulses, oil seeds, etc., are broken down into smaller particles and further homogenized, this result in fluids that can be termed as plant-based milk. These fluid extracts have particle size in the range of 5-20 $\mu$ m which is similar to that of cow's milk both in appearance as well as in its consistency (4). However, there has not been any specific or stated definition of such plant-based milk substitutes in any of the till date study or literature, a generic classification of plant derived milk substitutes is given as five categories, that can be states as follows-

- Cereal- corn, oats, rice, spelt milk
- Legume- pea, peanut, lupin, cowpea milk
- Seeds- flax seeds, sesame, sunflower, hemp milk
- Nuts- coconut, hazelnut, peanut, walnut, almond, cashew, pistachio milk
- Pseudo-cereals- teff, amaranth, quinoa milk

#### ***Types of plant based yoghurts/ fermented milk products:***

##### **Non-dairy bases:**

Soy, coconut and almond are some of the most common non-dairy yogurt bases. While soy was the most popular, with about 80% of global dairy-free yogurt launched in 2011, but the product developers' creativity has changed that to a great extent now. Ingredients like coconut milk, which emerged in appearances by 35% in 2016, have given the consumers with a few new alternates.

Recent developments indicate that almost any kind of non-dairy based milk can be successfully cultured which includes nuts, seeds, legumes and different types of grain based milk substitutes. The newly appeared section of nondairy yogurt bases includes oats, peas, flax, peanut, rice, hemp (5).

##### **Coconut:**

Coconut yogurt is a good alternative for people with lactose intolerance and supplies good key vitamins and minerals, along with live active cultures. Coconut yogurt is an adequate source of calcium providing 25- 30% of the daily value in each 6-ounce (170gms) serving. It doesn't contain any less protein in comparison to regular dairy-based yogurt, still when considering a diet which is a moderate in protein, high in plant fiber and healthy amount of fat, it can be opted as good alternative. Additionally in order to enhance the protein the yoghurt can be added or fortified with some nuts, hemp or protein powder. A 6 oz. serving of coconut milk yogurt gives 6 g of fiber, 75 Kcal of energy, 6 g of fat. Coconut yogurt has a natural sweetness with a pleasing and mild coconut flavor and a bit of a sour taste (6).

##### **Almond:**

Almond milk yogurt is formulated using almond milk as the base. Almond milk is made from whole almonds grounded along with water. If made properly it's delicious and it's also nutritionally dense because almond milk has a good capacity to retain the essential nutrients that are naturally found in almonds itself, these include antioxidants, good fat beneficial for heart health, fibers, vitamin E, along minerals such as magnesium. Moreover like soy yogurt, it is somewhat difficult to get an unsweetened version, and they are mostly added with see thickeners.

A 6 oz. serving of coconut milk yogurt gives 3 g of fiber, 129 Kcal of energy, 3 g of fat.

##### **Soy:**

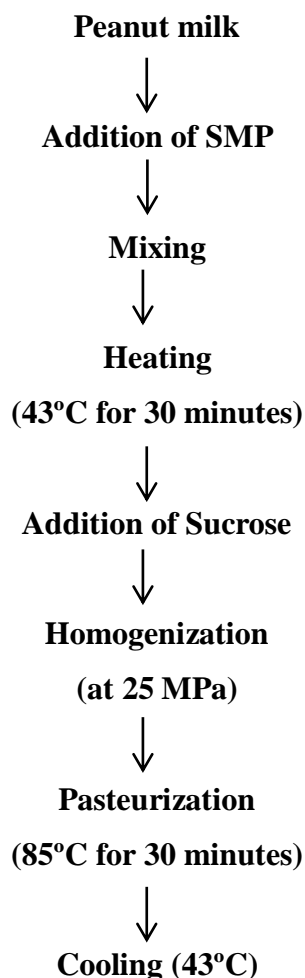
Soy Milk is used to make the soy yogurt. It is not only dairy free but also offers lots of benefits to the people who wish to eat less protein especially animal protein. There have been studies on the subject how various kinds of

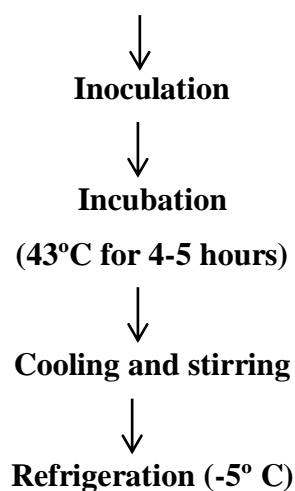
yogurt have helped people to achieve control on diabetes. One of such study was published in Journal of Food biochemistry. The study was very effective and showed how the soy yogurt was effectively able to block the enzymes that had direct impact on the carbohydrate digestion which was responsible for gradual increment in blood sugar level post meal. Also, a very interesting study was conducted on the rats wherein they were given the soy yogurt and it was found that they had healthy liver and also their cholesterol level was also on lower side. One of the major issue is that it is very difficult to find the soy yogurt which is unsweetened and the reason is that soy yogurt is thinner in nature and thickeners are most commonly added. A single serve contain, 45 percent of the daily value for calcium, 190 calories, 25 grams of carb (2 as fiber), 10 grams of protein, 6 grams of fat 45 percent of the daily value for calcium. The ingredients are: organic evaporated cane juice, pasteurized organic soymilk, organic cornstarch, organic natural flavor, tri-calcium phosphate and live active cultures.

### **Peanut:**

In 1967 at CFTR, India, Miltone using the lactic cultures, a product which was similar to Yoghurt was prepared. The one of the feature is that Peanut yoghurt is free from lactose if we compare with the standard dairy products. It is best suitable for the people who are lactose intolerant and this can provide them the same nutrition value and sensory qualities similar to the dairy based yogurt. In a number of attempts and trials by researchers, various methods were eventually developed in order to formulate peanut milk (7). Peanut milk is used to prepare the peanut yoghurt and the process starts with the soaking of the peanuts which is followed by grinding. It should be ensured that the thick paste like consistency is achieved. Then it goes to the filtration level (8). Alternatively, another process involves raw unsoaked and roasted peanuts that are grounded. We get the flour after grinding process. We need to add the water to make it emulsion like. Peanut milk and other products derived from these process are very good source of protein and for both young as well as elder people. It contains not only the protein but also the minerals, fatty acids like oleic and linoleic acids. They are very important for human body. Developing countries like India and other countries, peanuts are main source of proteins for the vegan population. Not just the young, elders as well as for those who are allergic to dairy product (7).

#### 1.1 Flow chart for preparation of peanut yogurt





### **Fortification:**

Substitute food is the food which is designed to resemble the common food on various aspects like texture, flavor, odor, appearance. The objective is to replace the food which it resembles and intends to replace it in partial or full. (9) As per codex, a food which has been notified as essential source of energy and has nutrients in the food supply, the substitute food can be used to replace it. And especially in the areas of public health, nutritional value and equivalence. Essential nutrient can be explained as “any substance which is generally consumed as important part of food. These are required for the growth, development of hale and hearty life. Plant-based milks is very cost effective in comparison to the dairy or the cow milk for all those are either short of money to buy the cow milk or lack access of the cow milk or are allergic to it. However, nutritionally, they lack and cannot be compared with the cow milk. All those who take cereal milk are more at risk of nutritional inadequacy in comparison to those who take cow milk. So, therefore it becomes important that plant-based milk should be fortified with protein, essential vitamins and minerals. Cereal-based beverages have Govt. regulation that they must label an advice that this product is not complete replacement of the cow milk for children under 5 years old for the reason it has less protein than cow’s milk (10). The growing children need adequate protein for their growth and development. Bovine milk can be used as child’s routine diet but plant-based milks have less amount of protein when compared to cow’s milk. So it becomes important that such products must be fortified before using as milk substitute. Another important nutrient is Calcium which is required for growth and development of the body. This is found in very limited quantity in cereals like rice and oats. So to provide the nutritional requirements to the consumers and to reduce their dependence on the supplements, it is very important that calcium fortification is done in the preparation of substitutes of the plant based milk.

All the products derived from the plant based milk like yogurt, with the help of the seeds, nuts, dry fruits, must be fortified before the consumption as nuts, dry fruits are very good source of healthy fats, vitamins and minerals. The additional protein source is used to fortify the plant based yogurt alternatives. This can lead to some impact on the viscosity. This change in the viscosity can further lead to production difficulties during shearing and pumping. It is very common practice for the product manufactures and developers to include stabilizers to achieve required texture and stability. Other substances like Starches and hydrocolloids are also used in achieving required viscosity, mouth coating, water binding and structure. But it is worth being careful during processing and homogenization and the stabilizers must be chosen carefully.

### **2. CONCLUSION:**

Plant-based fermented yogurt exhibit a colossal potential for the developing and growing market of health foods and it demands further research and investigation which can be achieved through expansion or advancement of processing technologies, techniques of fortification in order to develop a product which is nutritionally adequate as well as has a high percentage of acceptability in terms of the sensory characteristics like taste, texture and are also easily accessible. The focus must be towards providing a low cost, nutritionally dense alternative for those who suffer from some type of allergies related to animal-based milks. Preservation of such plant-based fermented products should be further studied by the exploration of newer technologies and their potential in processing. To promote the use of plant-based fermented products like yogurt among population sensitive to animal-based milk, further fortification with an appropriate fortificant using the right technology and also keeping up the bio-accessibility of nutriment during the whole process is a radical field of study. Thus the expanding consumer demand and the need to fulfill it keeping in mind the criteria of acceptability, plant-based fermented yogurt and similar products will remain an important area of research in the category of new product development of food science and technology.

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