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Traditional Fermented Food IDLI –A Mini Review

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A B S T R A C T

"Idli" is a traditional steam cooked, fermented food which is known for its typical flavor, characteristics taste, soft, spongy texture, high nutrient content, and easy digestibility. Fermentation enhances the protein and starch digestibility and also increases the bioavailability of minerals by reducing the activity of phytic acid and polyphenols. At present, there are hundreds of fermented foods with different base materials and preparation methodology. Each fermented food is associated with a unique group of microbiota, which increases the level of proteins, vitamins, essential amino acids and fatty acids. Research from past two decades have shown that the functional proteins and peptides present in fermented foods exhibits definite biological activities which is beyond its nutritional role .

Keywords: *Fermentation, Traditional food, Nutrients, anti-nutrients, Semolina, health benefits.*

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INTRODUCTION

"Idli" is a traditional steam cooked, fermented food which is known for its typical flavor, characteristic taste, soft, spongy texture, high nutrient content, and easy digestibility. It is one of the major breakfast food in India, Srilanka, Malaysia and Singapore [1,2]. Idli is also known as "Rice cake" is a traditional food of India. Ravaidli or Rave idli is a variation of idli, made with rava/Soji instead of the usual rice and urad decorticated pulse. The fermentation process breaks down the starches so fermented foods are more readily metabolized by the body [3]. The production of fermented foods is one of the oldest food processing technologies known to man. The diversity of the population of India has given rise to a large number of traditional fermented foods which have been extensively reviewed [4,5]. Fermented foods are produced world-wide using various manufacturing techniques, raw materials and microorganisms. However, alcoholic, lactic acid, acetic acid and alkali fermentation are different types of fermentation processes [4]. Fermentation enhances the protein and starch digestibility and also increases the bio-availability of minerals by reducing the activity of phytic acid and polyphenols [6].

Wheat (Triticum) is a worldwide cultivated crop from the arid areas of middle east to alluvial plains of Asia, America and Australia [7]. Semolina is made from hard durum wheat. It is the starchy endosperm part only which is separated from the bran and the wheat germ and then milled into flour. The term Semolina is derived from the Italian word "Semola" which is derived from the ancient Latin Simila, meaning "Flour" [3]. In North India semolina is known as "Suji" used for sweets such as "suji halwa" and in South India it was known as "Rava" or "Ravey" used to make savory foods like ravadosa, ravaidli, upma and puddings like "kesari" or "Sheera" [7].

Semolina is a good source of carbohydrate and protein and is an average source of dietary fibre [8]. A 100g of semolina contains about 68.43g of carbohydrate, 9.72g of dietary fibre, 0.74g of fat, 11.38g of protein, 8.94g of water, 0.29mg of thiamine (vitamin-B1), 0.04mg of riboflavin, 1.13mg of niacin and 0.1mg of vitamin B6[9].

Cereals are used as staple food, because it is one of the most important source of carbohydrates, proteins, vitamins, minerals and fibre [10]. Legumes known as "Poor man's meat, play an important role in human nutrition since they are rich sources of protein, calories, certain minerals and vitamins [11]. Food legumes are crops of the family Leguminosae also called Fabacae. Legumes enhances the protein content of cereal-based diets and may improve the nutritional status of the cereal-based diets. Cereal proteins are deficient in certain essential amino acids, particularly lysine. On the other hand, legumes have been reported to contain adequate amounts of lysine, but are deficient in S-containing amino-acids (methionine, cystine and cysteine) [12]. Hence combination of cereals and pulses helps to improve the overall protein quality of the fermented product [10].

Fermentation- a food preservation method

India is traditionally rich in fermented foods [13]. Traditional foods are the foods based on culture, custom, natural environment and consumed by people over long time. Through ages invented, modified, utilized and evolved traditional foods are developed to overcome the monotony in the diet. The traditional foods are held carefully and not changed quickly [14]. Generally, traditional food fermentations could convert foods such as raw meat and milk into products which has both improved keeping qualities and reduce the risk of illness [15].

Fermented foods such as idli and dahi were described as early as 700 BC [13]. At present, there are hundreds of fermented foods with different base materials and preparation methodology. Each fermented food is associated with a unique group of microbiota, which increases the level of proteins, vitamins, essential amino acids and fatty acids [16]. Fermentation is defined as a natural process through which microorganisms like yeast and bacteria convert carbohydrates such as starch and sugar into alcohol or acids and also promotes growth of probiotics, a beneficial bacteria [17]. The formed alcohol or acids in fermentation process acts as a natural preservative and give fermented foods a distinct zest and tartness [17]. Thus, a biochemically and organoleptically modified substrate is produced in fermented food resulting in an acceptable product for human consumption [18].

More than anything else, man has known the use of microbes for preparation of food products for thousands of years and all over the world a wide range of fermented foods and beverages contributed significantly to the diets of many people [17]. Lactic acid bacteria involved in many fermentation processes of milk, meats, cereals and vegetables because of their unique metabolic characteristic. Although many fermentations are traditionally dependent on inoculation from a previous batch starter cultures are available for many commercial processes such as cheese manufacture thus ensuring the consistency of process and product quality. It is anticipated that contribution of advances in lactic acid bacteria research towards improvement of strains for use in food fermentation will benefit both the consumer and the producer [19]. Three major types of microorganisms involved in food fermentations are bacteria, yeast and molds.

There is immense scope for commercialization of fermented foods as these foods are with improved nutritional value as well as functional foods [14]. Research from past two decades have shown that the functional proteins and peptides present in fermented foods exhibits definite biological activities which is beyond its nutritional role [20,21,22]. The study and understanding of traditional foods are important because it provides knowledge of the foods, useful for people engaged in community nutrition programs, because such foods are easily accepted in the communities. Also, for the development of new food products the information regarding traditional foods becomes important for modern markets. Further, the significance of such traditional foods is more appreciable when their nutritive value is known. In this respect, India has a rich treasure of traditional foods specially prepared for festivals, rituals and physiological conditions [14].

Theory of fermentation

Fermentation process can be classified as spontaneous and induced. Fermentation products contain chemical energy, which means that are not fully oxidized and their complete mineralization requires oxygen. Fermentation is less energetically efficient than oxidative phosphorylation (ATP is produced only by substrate-level phosphorylation). While fermentation of 1 molecule of glucose yields 2 molecules of ATP, in aerobic respiration 36 ATP molecules are formed. Transformation of private into end products, was the final step of fermentation which does not generate the energy, but produces NAD+ that is required for glycolysis [23].

Benefits of fermented foods

Globally, cereal grains are considered good substrates for fermentation and lactic acid bacteria are the predominant microorganisms used for fermentation [24]. Fermentation process preserves the food, and produce beneficial enzymes, B-vitamins, Omega-3 fatty acids, and various probiotics. Fermentation of foods results in breaking down the food to a more digestible form [25].

a. Improves the nutritional quality:

Cereals contribute the main staple diet of the low-income population which are poor in nutritive value. However, it has been shown that LAB fermentation improves the nutritive value and digestibility of such foods [26, 27]. Enzymes such as lipase, protease, and amylases are produced during fermentation and these enzymes in turn hydrolyze lipids, proteins, and polysaccharides respectively. Thus, the released nutrients contribute to the enhancement of the nutritional value of the products [28]. Fermentation also subsidizes to the enhancement of biovitamins, such as thiamine, riboflavin, niacin, or folic acid [29, 30, 31, 32, 2].

b. Preserves the food:

The inhibitory metabolites which are formed such as lactic acid, acetic acid, propionic acid, ethanol, and bacteriocins results in preservation of food [33]. In addition, the acids which are produced prolongs the shelf life by lowering pH to below 4 and this restricts the growth and survival of spoilage microorganisms and some pathogenic organisms [33, 34].

c. Eliminates the anti-nutrients:

Anti-nutrients are the natural or synthetic compounds that interfere with the absorption of nutrients, which can be destroyed by fermentation. Cereals, legume and tubers that are used for the production of fermented foods may contain significant amounts of antinutritional or toxic components such as phytates, tannins, cyanogenic glycosides, oxalates, saponins, lectins, and inhibitors of enzymes such as alpha-amylase, trypsin, and chymotrypsin. These substances reduce the nutritional value of foods by interfering with the mineral bioavailability and digestibility of proteins and carbohydrates. For example, phytic acid, which is found in legumes and seeds binds to minerals such as iron and zinc thus reduces mineral bio accessibility. However, phytic acid could be broken down during fermentation, thus making minerals bioavailable [25]. Hence fermentation of plant foods by yeast, molds, and bacteria helps to reduce the antinutritional and toxic components in plant foods [35].

d. Improved sensory attributes:

Fermentation leads to a general improvement in texture, taste and aroma of the food products [36,37,38,39]. Metabolic activities of microbial fermenters are responsible for the improvement in these attributes [34]. Organic acids together with free amino acids [37], alcohols, aldehydes, ketones, and carbonyl compounds are responsible for development of flavor and taste in fermented foods.

e. Detoxification:

Mycotoxins in food could be detoxified through LAB fermentation [40,41,42,43]. Detoxification by using LAB fermentation is more advantageous because it was a milder method which preserves the nutritive value and flavor of decontaminated food [44]. LAB fermentation has also been successfully used to detoxify casava toxins (cyanogens) following fermentation of cassava food products [19].

f. Production of nutraceuticals:

Nutraceuticals are food components that contribute to the health of the consumer through specific physiological action. Several nutraceuticals from bacterial origin have been added to food products [45]. The activity of LAB in fermented foods such as dairy products can be modified to increase the content of nutraceuticals through strain selection and process optimization [46,47]. As an example, fermented milks can be produced with LAB starter strains that produce high amounts of low- calorie polyols so as to reduce the sugar content [48].

g. Decreases the cooking time:

Foods with tough, difficult to digest or unpalatable raw ingredients could be improved by fermentation in turn reduces the time needed for cooking [25].

Effect of fermentation on foods

Fermentation of foods is the controlled action of microorganisms to alter the texture of food, to preserve (by the production of acids and alcohols) and to produce characteristic flavors and aroma. Changes produced by fermentation in food are discussed in table 1.

TABLE 1
Effect of fermentation on food

Parameter	Description	References
Texture	Complex changes in proteins and carbohydrates results in reduction of cooking time and softening of food	Batty and Folkman, [49]
Nutritional value	Hydrolysis of polymeric compounds, mainly polysaccharides and proteins by microorganisms improves digestibility	Fellows, [50]
Enrichment with	Protein, essential amino acids, essential fatty acids	Batty and Folkman, [49]
Flavor	Fermentation of sugars to acids results in increasing the acidic flavor with reducing sweetness, in some cases bitterness is reduced by enzymatic activity	Campbell et al., [51]
Aroma	The production of volatile compounds: amines, fatty acids, aldehydes, esters and ketones	Fellows, [50]
Color	Proteolytic activity, degradation of chlorophyll and enzymatic browning may produce brown pigments	Fellows, [50]
Taste	Induced removal of bitter tasting phenolic compounds	Batty and Folkman, [49]

NUTRITIONAL COMPOSITION OF IDLI

The nutritional composition and the quality of idli differs due to the utilization of an altered proportions and variety of the rice and black gram [52,53,54,55,56]. However, ratio with higher portion of rice has not been preferable, as the rice flavor was dominant [57]. Literature studies suggest that idli prepared in the ratio of 2:1 [58] and 3:1 [55] of rice and blackgram results with better quality and sensory properties.

Carbohydrate: Rice is the major source of carbohydrate and additionally black gram contributes to oligosaccharides (indigestible sugars)- raffinose, stachyose and verbascose in idli. These oligosaccharides are known to cause flatulence (intestinal gas production) and often elimination of these sugars is considered to be a challenging problem [59]. The process (soaking, fermentation and steam cooking) of idli preparation was beneficial as it reduced the oligosaccharide content up to 34%.

Protein: Black gram is the vital source of protein in idli [57]. The spongy texture of steamed idli was due to presence of surface-active proteins (globulin) and arabinogalacton (polysaccharide) [60]. Further, the protein efficiency ratio was found higher in the fermented idli than in unfermented idli mixture [61]. Regardless of the proportions of rice and black gram used during fermentation, marked increase of amino acids were evident. Especially, methionine content increased in the range between 10-60% of the initial content. Nutritionally, methionine increase was advantageous as many legumes lack in sulfur containing amino acids [62].

Lipid: Cereals and legumes are low in lipid content compared with oilseeds. Although it was not a serious nutritional problem in those food grains. During bacterial or fungal fermentation, the hydrolytic and metabolic changes in lipid fraction may influence the functional and sensory properties of fermented meal products [63].

Vitamins: Cereals serves as an important source of B-vitamins in human diet which was significantly lost or destroyed during food processing and cooking. Synthesize of B vitamins by LAB was an alternative way to reduce or compensate the losses of B vitamins [64,65,66,67]. Idli fermentation enhanced B-vitamins specially thiamine, riboflavin, folate, niacin, pyridoxine and vitamin B12 [62]. Studies have proven B-vitamins content increase two to three times after fermentation [54]. Vitamins participate in the essential cell regulation and metabolic processes. Recent studies on B-vitamins also proved that it also plays a role in prevention of cancer and cardiovascular diseases [68,69]. Though the rice and black gram itself contributes a certain amount of B-vitamins, further LAB and yeast participate in the fermentation process contributes to the enhancement. It has been reported that few types of yeasts involve in synthesis of riboflavin, thiamin and folate [70] and LAB in the synthesis of vitamin B12 [66].

Minerals: Idli also has been a source of minerals- calcium, magnesium, zinc, iron and phosphorous. It has been proved that fermentation increases the level of zinc and iron significantly by investigating the impact of fermentation on bio accessibility of zinc and iron in idli batter with different proportions of rice and black gram [71]. Conversely, steam cooking resulted in the loss (27-92%) of mineral contents. Apart from the health promoting components, idli also consists of antinutritional factors such as phytic acids, saponin and trypsin inhibitors that are mainly imparted from black gram [62]. The processing methods like soaking, fermentation and steaming in idli preparation helps to reduce or eliminate the antinutritional factors in idli. During the preparation, the phytic acid levels reduced approximately 35-40%. Likewise, fermentation and steaming also achieved complete reduction of the chymotrypsin inhibiting activity [62].

Starter: Use of starters in food fermentation has significantly increased the food quality in terms of final texture, nutrition and safety [72]. It was identified that Lactococcus lactis has ability to synthesize B-vitamins, particularly riboflavin and folate [73].

STUDIES RELATED TO SEMOLINA IDLI

Globally lifestyle diseases are increasing and are recognized as a major cause of morbidity and mortality. Study was done on the development of idli by utilization of multiflour mix to suit obesity and other lifestyle diseases. The nutritional and sensory attributes of the commonly used breakfast, idlis using healthy cooking methods of fermentation and steaming incorporating multiflour mix (Kutta ka atta or buckwheat flour, soyabean flour, lotus stem flour and flaxseed flour) was used to prevent and control obesity and associated lifestyle diseases. Multiflour mix was incorporated to idli's at different levels and referred as T1, T2, T3 and control as T0 respectively. The results showed that the most overall acceptable experimental treatment was T2 (10% buckwheat, 10% soyabean flour, 10% lotus stem flour, 1.5% flaxseed flour) prepared idlis. The authors reported that the prepared idlis were rich in fibre, calcium, iron, vitamin-A, vitamin-C. The cost of the manufactured experimental idli samples was lowest and could be affordable by the individuals of all socio-economic groups. Hence, it can be recommended for middle aged people suffering from obesity and associated lifestyle diseases [74].

Microbiological quality of semolina idli fortified with Whey Protein Concentrates (WPC) was studied [3]. Four different ratios of WPC at 5%, 10%, 15%, 20% and different holding times 10, 15, 20, 25 minutes for fermentation of batter were used in the study. Prepared products were tested for yeast and mold count, standard plate count, coliform count and cost of the product was also worked out for different treatment combinations. The coliform count was reported negative which means that hygienic practice was observed during the preparation of idli. The authors revealed the results that the microbial analysis of the prepared product was equally good, free from yeast and molds, standard plate count and coliform and is safe for consumption.

Utilization of dehydrated potato peels powder and carrot powder for development of product was studied [75]. The dehydration of potato peels and carrot were done through tray drying at 60-65˚C for 10 hours. The products prepared were uthappam, halwa and idli by incorporation of dehydrated potato peels powder and carrot powder mix in different proportions. Nutritional composition was determined using the food composition table [76]. Sensory evaluation was carried out using 9-point hedonic scale. The authors found that the products uthappam, halwa, idli were best with regard to their sensory attributes and overall acceptability at 5% incorporation level with potato peels powder and carrot powder. Authors reported that uthappam was rich in vitamin-C, calcium, polyphenol and total carotene per 100g respectively. Halwa was reported highest in calcium, carbohydrates, polyphenol and total carotene. Idli was rich in calcium, carbohydrate, polyphenol and total carotene content respectively.

A study formulated and analyzed the nutritional composition of value-added food products prepared by the incorporation of finger millet flour (Eleusinecoracana), pearl millet flour (Pennisetumglaucum) and drumstick leaves (Moringa oleifera) [77]. 'Idli', 'Dhokla', and 'Uthapam' were the three products prepared by incorporation of above-mentioned flour and drumstick leaves and analyzed for proximate constituents and total phenolic content. Results showed that 'idli', 'dhokla' and 'uttapam' were rich in calcium, vitamin-C and total phenolic content respectively. Incorporation of finger millet, pearl millet and drumstick leaves improved the nutritional composition of the products and their study concluded that these products prepared from millets and drumstick leaves have potential in the prevention of ageing and various diseases associated with oxidative stress.

In another study by Bishnoi et al [78] tried to standardize the instant rice idli mix and instant semolina idli mix incorporated with chicken meat powder (CMP), simultaneously. By using rice grit, salt, spice mix, sodium bicarbonate, citric acid, sodium carbonate and dry curry leaves, the control sample of rice idli mix was prepared and the control semolina idli mix was prepared by replacing the rice grit with semolina. Three different levels of chicken meat powder viz. 10, 20 and 30% were tried for development of both rice and semolina idli mixes. They stated that incorporation of chicken meat powder in rice idli mix at 20% level and in semolina idli mix at 30% level were found to be optimum for development of idlies. CMP incorporation in both the idli mixes decreased the percentage of moisture content and increased the protein, fat and ash content significantly. The authors finally reported that the percent protein content of reconstituted idlies prepared from rice idli mix and semolina idli mix incorporated with CMP were increased significantly from 3.38 to 8.28 and from 4.49 to 12.50 respectively.

The use of mango seed kernels for the development of antioxidant rich semolina idli and mathi was reported [79]. The purpose of their study was to utilize mango seed kernels. For this purpose, mango seeds were collected, washed, mango seed kernels separated, blanched for 2 minutes, dried at 60˚C for 6 hours and ground into flour. By incorporating 10-40% level of mango seed kernel flour, the above mentioned two products namely mathi and idli were prepared and evaluated for their sensory attributes. The authors examined that incorporation of mango seed kernel flour at 10 percent level was organoleptically acceptable. The energy, crude fat, crude fibre and total ash content of supplemented products were significantly higher as compare to control samples. A significant increase in mineral content of developed products namely calcium, magnesium and iron content and increased antioxidant activity were noticed by authors.

Four products such as idli, poha, dhokla and pop-ups were developed by supplementing the niger seeds (Guizotiaabyssinica) at different levels for different recipes and were sensorily evaluated using 9-point hedonic rating scale [80]. They noticed that incorporation of niger seeds higher than 20% decreased the acceptability due to dark colour and high fibre content. Idli, poha, dhokla and pop-ups were found to be acceptable at 15, 20, 10 and 9% level of supplementation of niger seeds respectively. The authors reported that the developed products were found to have increased nutritive value as compared to their respective control samples in terms of protein, fat, fibre, iron and *in vitro* protein digestibility. Supplementation of these products to the vulnerable groups can help in combating protein-energy malnutrition and anaemia.

Value-added semolina idli by incorporation of different treatments of fenugreek seeds flour i.e raw, soaked and germinated and to assess their sensory acceptability and nutrient contents was studied [7]. Fenugreek seeds flour was blended at 5, 10, 15 and 20% for T1, T2, T3 and T4 treatment respectively. Their study findings revealed (T1) was most acceptable for its color, flavor, texture, taste and overall acceptability. The authors reported that nutrient composition was improved for protein, ash, dietary fibre and mineral whereas fat, carbohydrate, moisture and energy level was decreased after value addition of fenugreek seeds flour at different levels. The authors concluded that germinated fenugreek seeds blends were found superior in nutritional quality compared to other flours blends.

Organoleptic evaluation of ravaidli and mathari fortified with mushroom powder [81] was reported. White button mushroom (*Agaricusbisporus*), oyster mushrooms (*Pleurotussajorcaju*) and paddy straw mushrooms (*Volvariellavalvacea*) were the three main species of mushrooms that were grown commercially in India. Among these, oyster mushroom possesses unique nutritional and medicinal values, characteristic aroma and taste. The products ravaidli and mathari were prepared by fortifying with oven dried mushroom powder at a level of T1(5%), T2 (10%), T3 (15%) and T4 (20%) respectively. The products were analyzed for its organoleptic characteristics. Analysis revealed that 10% fortification of mushroom powder in mathari was liked very much whereas 20% fortification of mushroom powder in ravaidli was liked extremely. The authors from the study concluded that mushroom powder could be applied in various Indian recipes as an excellent functional and nutritional food.

TABLE 2
Different types of semolina idli

Type of Idli	**Incorporated or fortified**	**References**
Multiflour mix semolina idli	Buckwheat flour, soyabean flour, lotus stem flour and flaxseed flour	Kumari and Ritu [74]
Semolina idli	Fortified with whey protein concentrate (WPC)	Yadav and Ranu [3]
Semolina idli	Potato peels powder and carrot powder	Shikha et al., [75]
Semolina idli	Finger millet flour, pearl millet flour and drumstick leaves	Gupta et al., [77]
Instant semolina idli mix	Chicken meat powder (CMP)	Bishnai et al., [78]
Semolina idli	Mango seed kernel	Kaur and Jaswinder [79]
Semolina idli	Niger seeds	Jain and Neerja [80]
Semolina idli	Fenugreek seeds	Pooja and Ritu [7]
Semolina idli	Fortified with mushroom powder	Verma and Vinita [81]

HEALTH BENEFITS OF FERMENTED FOODS

Fermented foods exhibit beneficial effects on health by reducing blood cholesterol levels, increasing immunity, protecting against pathogens, fighting carcinogenesis, osteoporosis, diabetes, obesity, allergies and atherosclerosis and also alleviating the symptoms of lactose intolerance [82]. Protein-rich fermented foods are becoming very popular in the recent past for the prevention of various cardiovascular diseases. The health benefits associated with fermented foods are often attributed to the bioactive peptides that are synthesized in the microbial degradation of protein by the bacteria involved in fermentation [83,84]. The protein- based bioactive components exhibit their biological properties by specifically hydrolyzing specific proteins (fibrinolytic enzymes), inhibiting certain metabolic enzyme (angiotensin-converting enzymes [ACE], and inducing physiological modulators with hormone- like activity [85,21].

Antithrombic properties

The potential source for fibrinolytic enzymes is fermented foods, which are useful in thrombolytic therapy to prevent rapidly emerging cardiovascular diseases in the modern world. The human body produces more than 20 enzymes to assist blood clotting, while only one is involved in the breakdown of the blood clot called "plasmin" [86]. To prevent thrombosis, daily intake of fibrinolytic enzymes from fermented food sources is recommended. Fibrinolytic enzymes with high specificity toward fibrin in fermented foods are preferred by therapeutic industries because of its lesser side effects and allergic reactions [87]. Also, fibrinolytic enzymes in fermented foods are acts as potential weapon for the treatment of cardiovascular diseases [86].

ACE- Inhibitory properties

Hypertension is the main cause of several risk factors such as heart failure, stroke, coronary heart disease, and myocardial infarction [20]. ACE-inhibitory peptides derived from food protein are gaining much importance for treating hypertension [21,22]. Antihypertensive peptides are one of the most studied bioactive peptides in the case of fermented foods, which inhibits ACE, is a key enzyme responsible for the conversion of angiotensin 1 to angiotensin 2, a strong vasoconstrictor. Angiotensin 2 causes vasoconstriction, reabsorption of water and sodium ions, which affects the electrolyte balance, volume and pressure of blood. Recently, the impact of fermentation by Lactobacillus plantarum on the formation of ACE-inhibitory peptides from pea protein has been showed [88].

Antimicrobial properties

Antimicrobial activity in fermented foods is mainly due to organic acids and antimicrobial peptides (bacteriocin). The synergistic activity of naturally occurring peptides, peptides produced by the fermenting microflora, and peptides formed by hydrolysis of dietary protein during fermentation gives the overall antimicrobial properties of peptides in fermented foods. Antimicrobial peptides produced by microorganisms shows potential application in food preservation and medicine [89]. Casein on hydrolysis during milk fermentation is a favorable source of antimicrobial peptides [22,90]. LAB isolated from various food such as fermented milk [91], fermented vegetables [92,93], and fermented meat and fish products [94] have shown to possess ability to produce antimicrobial peptides (bacteriocin). The future of antimicrobial peptides in fermented foods looks promising not only as nutraceuticals or natural drug in pharmaceutical industry but also as a preservative in food industry.

Antioxidant properties

Free radicals can result in cellular damage, which can give rise to several diseases such as cancer, diabetic, arthrosclerosis and arthritis [95]. Peptides are emerging as potential antioxidants in recent years in various protein rich fermented foods. The antioxidant activity of the peptides in fermented foods can be attributed due to their ability to scavenger free radicals, metal ion chelating property, and due to their ability to inhibit lipid peroxidation [96]. Antioxidant peptides have been reported in milk products such as yogurt [97], cheese [90], and Kefir [98]. Antioxidant peptides are also reported in sourdough fermentation of cereal flours by LAB [99]. The study showed that the radicle-scavenging activity of water/salt-soluble extracts prepared from fermented sourdoughs was significantly higher than that of chemically acidified doughs and the highest activity was found for whole wheat, spelt, rye, and kamut sourdoughs [99]. They concluded that the antioxidant properties were due to peptides formed on proteolysis of native cereal proteins by LAB. Hence fermented food enriched with antioxidant peptides can be a better alternative to synthetic antioxidant for the reduction of oxidative stress- related diseases.

Immunomodulatory properties

Peptides derived from food protein can enhance the immune system by lymphocyte proliferation, antibody synthesis, cytokine regulation, and by enhancing natural killer cell activity. Feeding mice with fermented milk have resulted in increases in various immune responses such as IgA- producing cells, macrophage activity, and specific antibody responses during infections [100]. In a recent study, [101] reported that peptide fraction of milk fermented with Lb. delbrueckii subsp. Bulgaricus LB340 displayed good immunomodulatory properties.

Milk fermented with a Lb. helveticus strain fed to mice for 3 days significantly increased the numbers of IgA-secreting cells in their intestinal mucosa, compared with control mice fed with similar milk incubated with a nonproteolytic variant of the same strain [102]. As there was immunostimulatory effect of fermented milk with proteolytic variant, the effect was attributed to peptides released from the casein fraction. Metabolites, especially peptides formed during food fermentation can have a positive impact on the immune system [103].

Anticancer properties

Cancer is the second leading cause of mortality worldwide and 99%-95% cancer cases are attributed to environment and life style [104]. Several studies have shown that several food components in fermented foods could lower the risk of cancer. For example; kefir, a traditional fermented milk product, and yogurt showed higher antiproliferative effects on human breast cancer cells in comparison to unfermented milk [105,106]. Several fermented foods and LAB in fermented foods have also been reported for their cancer protective effects [107]. Even the LAB isolated from fermented foods have shown to reduce the risk of certain cancers [108]. Peptides derived from food proteins have shown to possess anticancer properties in the last few years by preventing the different stages of cancer [109].

Anti-aging properties

Aging has been defined as a gradual decline in the physiological functions, which is experienced by all living beings over time, leading to age-associated injuries, diseases, and finally death. Research has been focused on effective strategies to delay this process and thus to increase both lifespan and well-being. The elevated amount of bioactive compounds and immunomodulatory effect of microorganisms present in fermented food products seem to be a promising alternative to anti- aging properties. Specific compounds such as genistein and daidzein in soybeans exhibiting an anti-aging related benefits have been reported [110].

Bone strengthening and glucose metabolism properties

Milk products are good source of calcium that may reduce bone resorption and promote bone remodeling and improves bone development. Kefir is a fermented product prepared from kefir grains degrades milk protein into various peptides with health promoting effects including antithrombic, antimicrobial and calcium-absorption enhancing bioactivities. The effect of kefir- fermented milk was investigated on osteoporosis patients and thus significant increase in bone mineral density (BMD) and Serum parathyroid hormone (PTH) was observed. PTH may help to promote bone re modelling after treatment with kefir [111]. The effect of fermented milk supplementation on glucose metabolism associated with muscle damage after acute exercise in humans was investigated. The result suggested that fermented milk supplementation improves glucose metabolism and alleviates the effects of muscle soreness after high intensity exercise, possibly associated with the regulation of antioxidant capacity [112].

CONCLUSION

Traditional foods are based on culture, custom, natural environment and consumed by people over long time. Through ages invented, modified, utilized and evolved traditional foods are developed to overcome the monotony in the diet. Also, for the development of new food products the information regarding traditional foods becomes important for modern markets. “Idli” is a traditional steam cooked, fermented food which is known for its typical flavor, characteristic taste, soft, spongy texture, high nutrient content, and easy digestibility. The production of fermented foods is one of the oldest food processing technologies known to man. Fermented foods exhibit beneficial effects on health by reducing blood cholesterol levels, increasing immunity, protecting against pathogens, fighting carcinogenesis, osteoporosis, diabetes, obesity, allergies and atherosclerosis and also alleviating the symptoms of lactose intolerance.

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