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The Nutraceutical Effects OF Dairy Products Fortification With Plant Components: A Review

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ABSTRACT: Nutrition scientists have mentioned that fortification of dairy products using plant resources (vegetables ,fruits, cereal, seeds , etc.) is one of the best ways to improve the overall nutrient intake of dairy products with minimal side effects. However, growing interest in the nutraceutical properties of dairy products has directed the attention of researchers to improve the quality of dairy products. Plant for example , soybean seed contains an array of nutritionally important constituents, many of them were previously dismissed as antinutrients, but more recent investigaions proved that they have prevented many diseases. Therefore ,incorporation of plant ingredients(dietary fiber, phenolic compounds .phytosterols, Isoflavones, and extra)in dairy products might have conferred several nutritional advantages .

I. INTRODUCTION

Plant callus/cell cultures were shown to possess a promising potential for the production of nutraceutical components These components exhibit several advantages .In the recent years, interest towards foods containing natural food components that improve the well-being of the general public, has increased. Those components, termed nutraceuticals or functional compounds, have been clinically proven to prevent the occurrence of certain diseases as long as they are consumed at recommended levels on a daily basis. Over the past 10 years, efforts have increased to develop suitable vehicles by which nutraceuticals are delivered to the human body. Dairy fortification is one of the most important processes for improvement of the nutrients quality and quantity in food. It can be a very effective public health intervention due to the high consumption rate of dairy products. For the above mentioned, dairy products fortified with one or more of plant component could be the best nutraceutical food. This review describes a well-rounded picture of the current understanding of structural, functional, and nutritional properties of plant components which could be used for dairy products fortification and highlights the recent progresses in production of value-added nutraceuticals plant component to dairy product via dairy products properties.

II. LITERATURE SURVEY

Plant contains an array of nutritionally important constituents. (Nestle 2013). Many of them were previously dismissed as antinutrients, but more recent findings suggest they might have significant roles in disease prevention, Jelena Medic et al 2014.

1- Dietary fiber :

A- Definition of plant fiber:

Plants contain compounds including cellulose, hemicellulose, lignin and pectin collectively known as dietary fiber, that the enzymes in your intestines cannot digest.

Dietary fiber has long history, its term originating with Hipsley (1953) who coined dietary fiber as a non-digestible constituents making up the plant cell wall and further its definition has seen several revisions. Botanists define fiber as a part of the plant organs, chemical analysts as a group of chemical compounds, consumer as a substance with beneficial effects on human health and for the dietetic and chemical industries dietary fiber is a subject of marketing. Later dietary fiber was defined as a ubiquitous component of plant foods and includes materials of diverse chemical and morphological structure, resistant to the action of human alimentary enzymes (Kay 1982). Trowell et al. (1985)reported that "Dietary fiber consists of remnants of plant cells resistant to hydrolysis (digestion) by the alimentary enzymes of man", whose components are hemicellulose, cellulose, lignin, oligosaccharides, pectins, gums and waxes.

American Association of Cereal Chemists (AACC) in 2000 defined dietary fiber as the edible parts of plant or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine with complete or partial fermentation in the large intestine. Dietary fiber includes polysaccharides, oligosaccharides, lignin and associated plant substances. During the year 2001, Australia New Zealand Food Authority (ANZFA) defined dietary fiber as that fraction of the edible part of plants or their extracts, or analogous carbohydrates, that are resistant to digestion and absorption in the human small intestine, usually with complete or partial fermentation in the large intestine. The term includes polysaccharides, oligosaccharides and lignins. The panel on the definition of dietary fiber constituted by National Academy of Science during the year 2002 defined the dietary fiber complex to include dietary fiber consisting of non-digestible carbohydrates and lignin that are intrinsic and intact in plants, functional fibers consisting of isolated, non digestible carbohydrates which have beneficial physiological effects in humans and total fiber as the sum of dietary fiber and functional fiber.

B-Classification of dietary fiber:

Dietary fiber is classified into two categories such as water- insoluble/less fermented fibers: cellulose, hemicellulose, lignin and the water- soluble/well fermented fibers: pectin, gums and mucilages (Anita and Abraham 1997& Tungland and Meyer 2002).

Chau and Huang 2003reported that fiber-rich fractions (FRFs) including soluble and insoluble dietary fibers (SDF and IDF), alcohol-insoluble solid (AIS), and water-insoluble solid (WIS) were isolated from the peel of Citrus sinensis L. cv. Liucheng .The peel was rich in insoluble FRFs (IDF, AIS, and WIS; 476-515 g kg(-1) of peel), which were mainly composed of pectic substances and cellulose, and also contained pectic polysaccharide-rich SDF (94.1 g kg(-1) of peel). These insoluble FRFs had water-holding capacities (15.5-16.7 mL g(-1)), oil-holding capacities (2.35-5.09 g g(-1)), cation-exchange capacities (454-997 mequiv kg(-1)), and swelling properties (14.6-21.1 mL g(-1)) much higher than those of cellulose. These results recommended the consumption of these peel insoluble FRFs of desired physicochemical properties as sources of food fibers or low-calorie bulk ingredients in food applications requiring oil and moisture retention

C-Important Of Fortified Dairy Products with Dietary Fibers:

Milk, defined as the fluid secreted by the mammary glands of mammals, contain no fiber. Dairy products have recently come under fire from researchers showing the detrimental effects of saturated fat and cholesterol in the body. Researchers reported positive effects of fiber in the diet. Fortification of dairy products using natural resources (fruits, cereal, etc.) is one of the best ways to improve the overall nutrient intake of food with minimal side effects. .Consumption of products containing high fiber may prevent or decrease hypertension, hypercholesterolemia, obesity [Van Dam and Seidell2007] , gastrointestinal disorders [. Elia and Cummings2007], coronary heart disease [David et al 1990, Pereira et al 2004 and Mann 2007], diabetes [Anderson et al 2004] ,[Venn and Mann ,2004] ,[Au et al 2013], and cancer [Bingham et al 2003and Pereira et al 2004]. Legumes represent, together with cereals, the main plant source of proteins in human diet. They are also generally rich in dietary fibre and carbohydrates. Minor compounds of legumes are lipids, polyphenols, and bioactive peptides. Fortifying yogurt or dairy products with fiber is of increasing interest to create functional foods with health benefits and improve their functionality. Fortifying yogurt with dietary fiber would complement its healthy properties Estrella Fernández-Garía, 1998. inulin is a prebiotic fiber that is fermented in the lower intestine by the beneficial bacteria, Bifidobacterium. Because inulin is a lower calorie carbohydrate, it is beneficial in formulating reduced and low calorie foods. Inulin has little or no impact on blood sugar making it a quality sugar substitute in low-glycemic foods.

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D-Effect of plant fiber fortification on dairy products properties:

The importance of food fibers coupled with the fact that milk and milk products are devoid of dietary fiber has led to the successful development of various dietary fiber fortified dairy products such as yoghurt (Fernandez-Gracia et al. 1998; Chau and Huang 2003;Staffolo et al. 2004; Garcia-Perez et al.2005; Kip et al. 2006; Aryana et al. 2007and Guggisberg et al. 2009), cheese (Buriti et al. 2007, 2008 and Cardarelli et al.2008) , ice cream (Singh et al. 2005; Akalin et al.2008 and Ahmadi et al. 2012), dairy dessert (Tarrega and Costell 2006), lactic beverage (de-Castro et al. 2009; Villegas and Costell 2007).

Estrella Fernandez-Garcıa. and McGregor 1997 Fortified sweetened plain yogurt with insoluble dietary fiber from five different sources (soy, rice, oat, corn and sugar beet). Fiber addition caused acceleration in the acidification rate of the experimental group yogurts, and most of the fortified yogurts also showed increases in their apparent viscosity. Soy and sugar beet fibers caused a significant decrease in viscosity due to partial syneresis. In general, fiber addition led to lower overall flavor and texture scores. A grainy flavour and a gritty texture were intense in all fiber-fortified yogurts, except in those made with oat fiber. Oat fiber gave the best results; differences with controls in terms of flavor quality scores not being statistically significant. The evolution of organic acids during the fermentation and cold storage of control and oat fiber-fortified yogurts showed a similar pattern; only acetic and propionic acids were found in significantly higher amounts in the fiber fortified product.

Calorie-reduced yogurts that were fortified with 1.32% oat fiber were prepared from lactose-hydrolyzed milk, alone and supplemented with 2 and 4% sucrose or with 1.6, 3.6, and 5.5% fructose. Fiber addition improved the body and texture of unsweetened yogurts but lowered overall scores for body and texture in yogurts sweetened with sucrose Estrella Fernández-Garía1998.

The maximum acceptable amount of date fiber in fortified yogurt with potential beneficial health effects is 3%. Many researchers evaluated the effect of dietary fiber on dairy products and yogurt quality. The addition of 1.32% oat fiber improved the body and texture of unsweetened yogurt and decreased the overall flavor quality [Fernández et a1 1998].

Fiber of various sources is added to dairy products because of its water-holding capacity and its ability to increase the production yield, reduce the lipid retention, improve textural properties and structure, and reduce caloric content by acting as a bulking agent Larrauri 1999.

McDello Staffolo et al 2004 studied the effects of different dietary fibers on sensory and rheological properties of yogurts fortified with these fibers. Commercial fibers from apple, wheat, bamboo or inulin were used. Rheological characterization was performed by dynamic, shear and compression–extrusion assays. Storage time and type of fiber were significant factors for instrumental analysis. Syneresis and pH did not show any difference, while only apple fiber yogurt showed color differences compared to control. An untrained sensory panel analyzed consumer acceptability. Even though fibers modified certain rheological characteristics of the plain yogurt, the panelists awarded the supplemented yogurts scores indicating acceptability .Native inulin, such as Oliggo-Fiber® Instant inulin, is an extremely versatile product for fiber fortification. As a soluble source of fiber, it can be easily incorporated into dairy products, including yogurt, ice cream and cheese. It also allows for fiber fortification into beverages, such as meal replacements, dairy-based beverages

Date fiber (DF), a by-product of date syrup production, is a good source of dietary fiber. The effect of fortification with DF on fresh yogurt quality was investigated by Hashim et al 2009.Control yogurt (without fiber), yogurt fortified with 1.5, 3.0, and 4.5% DF, and yogurt with 1.5% wheat bran (WB) were prepared. Yogurt fortified with up to 3% DF had similar sourness, sweetness, firmness, smoothness, and overall acceptance ratings as the control yogurt. Sensory ratings and acceptability of yogurt decreased significantly when increasing DF to 4.5% or using 1.5% WB. Flavoring yogurt fortified with 4.5% DF with vanilla did not improve flavor or overall acceptance ratings. Thus, fortifying yogurt with 3% DF produced acceptable yogurt with beneficial health effects.

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Chen et al 2010 reported that a pudding, and a low-fat ice cream, that have been fortified with soluble soybean polysaccharide at levels of 4%, and 2%, respectively were within acceptable ranges of rheological parameters and other physical stability measurements and were judged to be acceptable by sensory analyses.

Deepika Yadav et al 2012 reported that soymilk is a well known protein enriched biofunctional food, but its acceptability was reduced due to the presence of complex sugars which gives soymilk beany flavor. However, fermentation had proven earlier reduction of such off-flavor in soymilk. Thus, soymilk was supplemented with 4% skim milk powder, 1.5% inulin and 10% strawberry pulp and fermented with combination of yoghurt culture NCDC-262 and L. acidophilus NCDC-195 (1:2) at 42oC for 6h. The yoghurt thus formed was evaluated for its antioxidative potential by ABTS, DPPH and FRAP method and was found to show 92% ABTS inhibition, 983.15 µM of TEAC, 54% DPPH reduction and 1364.25 µM FRAP reduction. Thus, soy based probiotic yoghurt can be nutritionally beneficial nutraceutical with persuasive antioxidative potential.

Replacement of skim milk powder with white sweet lupin flour up to 25 % in ice milk did not affect the organoleptic properties and improved the nutritional value(El Sisi et al (2014) Microbial production of value-added nutraceuticals was reported by Jian Wang et al 2016.

Sajad Ahmad Wani , Pradyuman Kumar2016reported that Fenugreek (*Trigonella foenum-graecum*) is a legume and it has been used as a spice throughout the world to enhance the sensory quality of foods. It is known for its medicinal qualities such as antidiabetic, anticarcinogenic, hypocholesterolemic, antioxidant, and immunological activities. Beside its medicinal value, it is also used as a part of various food product developments as food stabilizer, adhesive, and emulsifying agent. More importantly it is used for the development of healthy and nutritious extruded and bakery product.. The above-mentioned studies on fenugreek suggest that the functional, nutritional and therapeutic characteristics of fenugreek can be exploited further in the development of healthy products.

Dibazar et al 2016 study the effect of grape fiber and Lactobacillus Fermentum viability, physicochemical and sensorial properties in yoghurt during storage, using response surface methodology (RSM). Amounts of grape fiber, and storage time were in the range of 0- 1.2%, 0-1% and 3-21 day, respectively. The results indicated that Lactobacillus Fermentum increased by increasing grape fiber during storage significantly. Moisture and syneresis of samples reduced significantly by increasing the amounts of fiber. Flavor scores decreased as grape fiber increased significantly. using 0.9% grape fiberand 12 day storage were found as optimum conditions for producing probiotic kiwi fruit yogurt.

2-Omega- 3 and omega -6 fatty acids:

The group of poly-unsaturated fatty acids (PUFAs) is divided into two groups: omega-3 (n-3) and omega-6 (n-6) poly-unsaturated fatty acids (PUFA), Two PUFAs are called “essential fatty acids” since they cannot be synthesized in the human body and are vital for physiological integrity. Therefore, they must be obtained from the diet. One is linoleic acid (LA, C18:2n-6) and belongs to the n-6 family. The other one is α-linolenic acid (LNA, C18:3n-3) belonging to the n-3 family. These essential parent compounds can be converted in the human body to long-chain (LC) fatty acids, but humans cannot interconvert n-3 and n-6 fatty acids .LA can be converted to arachidonic acid (AA, C20:4n-6) and further on to longer chain derivates, and LNA to eicosapentaenoic acid (EPA, C20:5n-3) in a first step and docosahexaenoic acid (DHA) (C22:6n-3) in a next step. Omega-3 is considered an essential nutrient since it is the precursor of EPA and DHA, which cannot be synthesised in the human body (Awaisheh et al. 2005). Eicosapentaenoic acid and DHA are essential for development of the brain, concentration, and the learning ability of children, as well as promoting health in the general population (Milner and Alison 1999). α-Linolenic acid α-Linolenic acid are hypotriglyceridemic, improves cardiovascular function [Sugano 2006]

ALA is found in flax seed and various vegetable oils and nuts (Gruenwald 2009).. flaxseed is the most abundant source of α-linolenic acid (ALA). Its content in flaxseeds accounts for 53% of total FA (Bloedon and Szapary 2004). Moreover, fatty acid profile of flaxseed is characterised by an excellent ratio of ω 6,ω 3 FA. The excess of short- and medium-chain saturated FA and low level of unsaturated ω 3 FA in human diet are a common pattern observed in the Western countries. It is also considered as an atherogenic factor and the primary cause of cardiovascular diseases (Adkins and Kelley 2010).

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3-Phenolic compounds:

Phenolics have significant attention in recent years due to their antioxidant, anti-inflammatory, anti-mutagenic and anti-clotting power which has been correlated with a declined risk of cardiovascular diseases and cancer development.[Fresco et al 2010, . Loke et al 2010] . The major dietary source of phenolic compounds is fruit[Record et al 2001]. It has been suggested that fruit juices [Coisson et al 2005], powders[Wallace, M. Giusti (2008)]and extracts have the potential to be used as functional ingredients in the food industry including dairy sector.

Plant callus/cell cultures were shown to possess a promising potential for the production of mainly anthocyanin and other phenolic in grapes [Hiroyuki et al 2002], carrots [Gläßgen et al 1992 and Cherries [Blando et al 2004]. These in vitro cultures exhibit several advantages over fresh fruit extracts such as possibility of continuous production of natural compounds[Blando et al 2004]. Grape seed is a by-product derived from the industries, and it contains a high amount of polyphenols, mainly proanthocyanidins (Correddu et al 2016)

4- Phytosterols:

Phytosterols is safe food ingredients (Engel and Schubert2005; Taşan et al. 2006).; plant sterols and stanols have many applications as food additives and food ingredients (Ostlund et al. 2003).Phytosterols include sterols and stanol esters which are steroid alcohols ,The phytosterols have shown potential in inhibiting cancers of the, lung, ovaries ,stomach and breasts (Woyengo et al. 2009). Plant stanols effectively reduce the absorption of all sterols from the digestive tract, hence also decreasing serum cholesterol levels. Jones et al. (1999) mentioned that added 1.7 g/day of phytosterols in the diet of hypercholesterolaemic men had the effect of lowering blood cholesterol. Daily consumption of low-fat milk containing 1.6 g phytosterols reducing Low Density Lipoprotein (LDL) levels by 8% after 6 weeks (Hansel et al. 2007). The European Food Safety Association (EFSA) and USA Food and Drug Administration (FDA) have accepted plant sterols as food ingredients (EFSA 2009, FDA 2009).

Phytosterols are plant-originated fractions found in vegetable oils, seeds, nuts, cereals and beans (Clifton et al. 2004). The major phytosterols in nature are β-sitosterol, campesterol and stigmasterol (Mensink et al. 2002). B-sitostanol, campestanol and stigmastanol are saturated phytosterols that have no double bond in the ring structure. Phytosterols and stanols are structurally identical to cholesterol, but they are distinguishable by the presence of additional methyl or ethyl groups in their side chain (Abumweis et al. 2006). Phytosterol-enriched dairy products (high or low in fat) seem to be as effective as nondairy products in reducing serum LDL cholesterol (Clifton et al. 2004). However, no significant change in high-density lipoprotein cholesterol (HDL-C) and fat-soluble vitamins was observed (Westrate and Meijer 1998; Gylling and Meittinen 1999). A daily intake of 1.7 g of phytosterols and stanols is recommended to achieve optimal cholesterol-lowering action (Awaisheh et al. 2005).

Dorothy Mackerras et al2013 mentioned that Phytosterols are an example of a functional food. Small amounts of phytosterols are found naturally in foods such as unrefined olive oil. More recently they have been extracted from "tall oils" which are by-products of wood pulp. Tall oils are not a traditional food in Australia and New Zealand and so phytosterols derived from them are classed novel food ingredients by FSANZ. Specific permissions following pre-market safety assessment are required before they can be added to foods.

Phytosterols have shown no inhibitory effects on growth and acid development by yoghurt starter cultures and had a positive effect on viability of single and mixed probiotic strains upon incubation and chilled storage (Awaisheh et al. 2012). Soy Phytosterols is Hypocholesterolemic

5- Isoflavones:

Isoflavones can be found in many foods but the best known source is the soy bean (Messina 1999). Red clover is another source of isoflavones. As red clover is not suitable for direct consumption, the isoflavones extracted from red clover are used as supplements in the food industry .Isoflavones are secondary vegetable substances, which can act as oestrogens in the body and have protective functions .Soy isoflavones is Weak estrogenic activity [Sakai andkogiso

2008], hypocholesterolemic [Murphy 2008, Vincent andFitzatrick2000], might prevent osteoporosis and certain cancers [Vincent andFitzatrick2000, Weaver and Cheong2005

Isoflavones have potent antioxidant properties, comparable to that of the well known antioxidant vitamin E. The antioxidant power of isoflavones can reduce the long-term risk of cancer by preventing free radical damage to DNA. Genistein is the most potent antioxidant among the soy isoflavones, followed by daidzein. In nature, isoflavones usually occur as glycosides and, once deconjugated by the intestinal microflora, the isoflavone can be adsorbed into the blood (Awaisheh et al. 2005). It should be borne in mind that most isoflavones show poor solubility in water and lead to flavour defects such as bitterness and a beany taste.

6- Sphingolipids:

Sphingolipids are anticarcinogenic [Schmelz et al1996]Hypocholesterolemic [Imaizumi et al 1992,Kobayashi et al 1997], and regulates immune function [Olivera andRivera 2005]

7-Phospholipids Hypocholesterolemic [Sugano 2006], reduces fat accumulation in the liver [Jimenez et al 1990], maintain brain functions (memory and learning abilities) [Linoleic acid Essential fatty acid, hypocholesterolemic [Sugano 2006].

8- Lectins:

Lectins are anticarcinogenic [Sugano 2006 and Friedman and Brandon 2001]

9- Trypsin:

Trypsin was reported as inhibitor Anticarcinogenic [Sugano 2006 and Friedman and Brandon 2001]

REFERENCES

[1] Adkins Y and Kelley D S , " Mechanisms underlying the cardioprotective effects of omega-3 polyunsaturated fatty acids". Journal of Nutritional Biochemistry 21, pp. 781–792, 2010.
[2] Ahmadi A, Milani E, Madadlou A, Mortazavi SA, Mokarram RR, Salarbashi D ," Synbiotic yogurt-ice cream produced via incorporation of microencapsulated lactobacillus acidophilus (la-5) and fructooligosaccharide". J Food Sci Technol. doi:10.1007/s13197-012-0679-y, 2012.
[3] Akalin AS, Karagozlu C, Unal G." Rheological properties of reduced-fat and low-fat ice cream containing whey protein isolate and inulin". Eur Food Res Technol.;227 , pp 889–895, 2008.
[4] Anderson,J.W Randles, K.M. Kendall,C.W. JenkinsD.J., "Carbohydrateand fiber recommendations for individuals with diabetes: a quantitative assessment and meta-analysis of the evidence" , J. Am. Coll. Nutr., 23, pp. 5–17 , 2004..
[5] Anita FP, Abraham P." Clinical dietetics and nutrition. Calcutta: Delhi Oxford University Press". pp. 73–77, 1997.
[6] Aryana KJ, Plauche S, Rao RM, McGrew P, Shah NP. Fat-free plain yoghurt manufactured with inulins of various chain lengths and Lactobacillus acidophilus. J Food Sci. ;72(3), ppM79–M84. 2007
[7] Au MM, Goff HD, Kisch JA, Coulson A, Wright AJ Effects of soy-soluble fiber and flaxseed gum on the glycemic and insulinemic responses to glucose solutions and dairy products in healthy adult males. J Am Coll Nutr.;32(2) , pp:98-110, 2013
[8] Awaisheh S S, Haddadin M S Y and Robinson R K Incorporation of selected nutraceuticals and probiotic bacteria in to a fermented milk. International Dairy Journal 15 1184–1190. 2005
[9] Awaisheh S S, AL-Dmoor H, Omar S H, Hawari A and Alroyli M Impact of selected nutraceuticals on viability of probiotic strains in milk during refrigerated storage at 4 °C for 15 days. International Journal of Dairy Technology 68 , pp. 268–273,, 2012
[10] Bingham,S.A. Day,N.E. . Luben,R Ferrari, Slimani,P. N. Norat,TClavel-Chapelon,. F. Kesse, E. Nieters.A, BoeingH. (Dietary fibre in food and protection against colorectal cancer in the European Prospective Investigation into Cancer and Nutrition (EPIC): an observational study Lancet, 361 pp. 1496–1501 .2003.
[11] Blando,F. Gerardi, C. NicolettiISour cherry (Prunus cerasus L) anthocyanins as ingredients for functional foodsBioMed Res. Int., pp. 253–258,2004
[12] Bloedon L T and Szapary P O Flaxseed and cardiovascular risk. Nutrition Reviews 62 18–27, 2004.
[13] Buriti FCA, Cardarelli HR, Filisetti TMCC, Saad SMI. Synbiotic potential of fresh cream cheese supplemented with inulin and Lactobacillus paracasei in co-culture with Streptococcus thermophilus. Food Chem. ;104(4):1605–1610, 2007.
[14] Buriti FCA, Cardarelli HR, Saad SMI. Influence of Lactobacillus paracasei and inulin on instrumental texture and sensory evaluation of fresh cream cheese. Braz J Pharm Sci. 44(1):75–84, 2008
[15] Cardarelli HR, Buriti FCA, Castro IA, Saad SMI. Inulin and oligofructose improve sensory quality and increase the probiotic viable count in potentially synbiotic petit-suisse cheese. LWT-Food Sci Technol. 41(6):1037–1046, 2008
[16] Chau CF1, Huang YL.2003Comparison of the chemical composition and physicochemical properties of different fibers prepared from the peel of Citrus sinensis L. Cv. Liucheng. J Agric Food Chem. 51(9):2615-8, 2003

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 3, Issue 2 , February 2016

[17] Chen W, Duizer L, Corredig M, Goff HD Addition of soluble soybean polysaccharides to dairy products as a source of dietary fiber. J Food Sci. 75(6):C478-84. 2010
[18] Clifton P M, Noakes M, Sullivan D, Erichsen N, Ross D, Annison G, Fassoulakis A, Cehun M and Nestel P Cholesterol-lowering effects of plant sterol esters differ in milk, yoghurt, bread and cereal. European Journal of Clinical Nutrition 58 503–509,2004
[19] Coisson,J. Travaglia,F. Piana, G. Capasso,M. ArlorioM. Euterpe oleracea juice as a functional pigment for yogurt .Food Res. Int., 38 , pp. 893–897,2005.
[20] Correddu F. Gaspa, G. Pulina, G. Nudda A Grape seed and linseed, alone and in combination, enhance unsaturated fatty acids in the milk of Sarda dairy sheep J OF Dairy Science Volume 99, Issue 3, PP1725–1735., 2016 .
[21] David L. Hoyda, Paul J. Streiff, Edward Method of making fiber enriched yogurt, US patent 4971810 A ,1990.
[22] De-Castro FP, Cunha TM, Ogliari PJ, Teofilo RF, Ferreira MMC, Prudencio ES. Influence of different content of cheese whey and oligofructose on the properties of fermented lactic beverages: study using response surface methodology. LWT-Food Sci Technol. ;42,PP:993–997,2009.
[23] Deepika Yadav, Shilpa Vij, Subrota Hati, Brij Pal Singh, Meenakshi Dhanday, Minakshi Dahiya, Vandna VandnaEvaluation of Total Antioxidant Activity of Soy Yoghurt Indian J.OF dairy Science. 65, (3), pp220-224,2012.
[24] Dibazar, P.; Khosrowshahi Asl, A.; Zomorodi, Sh."Optimization grape fiber and chitosan amounts in fruit yoghurt using response surface methodology (RSM)". Journal of Food Science & Technology Vol. 13 Issue 51, p75-88. 2016,
[25] Dorothy Mackerras , Dennis Thomas, Jason March, Jenny Hazelton Food Fortification: A Regulator's PerspectiveHandbook of Food Fortification and Health , Part of the series Nutrition and Health pp 305-318, 2013
[26] EFSA European food safety association, scientific opinion: plant stanols and plant sterols and blood LDL-cholesterol. The EFSA Journal 1175 pp1–9 ,2009.
[27] Elia,M. CummingsJPhysiological aspects of energy metabolism and gastrointestinal effects of carbohydrates Eur. J. Clin. Nutr., 61, pp. 40–74, 2007
[28] El-Sisi A.S., Nadia A.Abou Zeid, Zedan A.N., and Ali A. O. M. Replacing Skim Milk Powder With White Sweet Lupin Flour For Ice Milk ManufactureAexandria J. Of Food Science and Tchnology Vol 11No 2., 2014
[29] Engel R and Schubert H Formulation of phytosterols in emulsions for increased dose response in functional foods. Innovative Food Science and Emerging Technologies 6 233–237.
[30] Estrella Fernandez-Garcı J.and U. McGregorFortification of sweetened plain yogurt with insoluble dietary fiber. Z Lebensm Unters Forsch A 204pp 433,1997
[31] Estrella Fernández-Garía, , John U. McGregor, Sandra TraylorThe Addition of Oat Fiber and Natural Alternative Sweeteners in the Manufacture of Plain Yogurt1Journal of Dairy ScienceVolume 81, Issue 3, March pp 655–663,1998.
[32] FDA (U.S. Food and Drug Administration) Code of Federal Regulations, Title 21, Volume 2, [Internet document] URL, 2009.
[33] Fernandez-Gracia E, McGregor JU, Traylor S. The addition of oat fiber and natural alternative sweeteners in the manufacture of plain yogurt. J Dairy Sci.;81pp 655–663,1998
[34] Fresco,P. Borges,F. Marques,M. DinizCThe anticancer properties of dietary polyphenols and its relation with apoptosis Curr. Pharm. Des., 16), pp. 114–134, 2010 Friedman M, Brandon DL (2001) Nutritional and health benefits of soy proteins. J Agric Food Chem 49pp1069–1086,2005
[35] Garcia-Perez FJ, Lario Y, Fernandez-Lopez J, Sayas E, Perez-Alvarez JA, Sendra E. Effect of orange fiber addition on yoghurt color during fermentation and cold storage. Colour Res Appl. ;30(6):457–463,2005
[36] Gläßgen,W.E. Wray,V.. Strack,D.W Metzger,J. SeitzH.U)Anthocyanins from cell suspension cultures of Daucus carota. Phytochemistry, 31, pp. 1593–1601, 1992
[37] Guggisberg D, Cuthbert-Steven J, Piccinali P, Butikofer U, Eberhard P. Rheological, microstructural and sensory characterization of low-fat and whole milk set yoghurt as influenced by inulin addition. Int Dairy J19(2)pp107–115. 2009;
[38] Gylling H and Meittinen T A Cholesterol reduction by different plant stanol mixtures and with variable fat intake. Metabolism 48 575–580,1999
[39] Hashim I.B., Khalil A.H, Afifi H.S. Quality characteristics and consumer acceptance of yogurt fortified with date fiberJournal of Dairy Science. Volume 92, Issue 11, November 2009, Pages 5403–5407 ,2009.
[40] Hansel B, Nicole C, Lalanne F et al. Effect of low fat fermented milk enriched with plant sterols on serum lipid profile and oxidative stress in moderate hypercholesterolemia. American Journal of Clinical Nutrition 86 790–796,2007.
[41] Hipsley EH. Dietary "Fibre" and pregnancy toxaemia. Br Med J. ;2 pp:420–422 ,1953.
[42] Hiroyuki, H. Kousuke, N. Eiji, O. Mariko, K. Yoshihito, H. Setsuro, K. Takeshi K Enhanced anthocyanin production from grape callus in an air-lift type bioreactor using a viscous additive-supplemented mediumJ. Biosci.Bioeng., 94, pp. 135–139,2002.
[43] Imaizumi K, Tominaga A, Sato M, Sugano M Effects of dietary sphingolipids on levels of serum and liver lipids in rats. Nutr Res 12 pp543–548, 1992.
[44] Jelena Medic Christine Atkinson, Charles R. HurburghJr. Current Knowledge in Soybean CompositionJournal of the American Oil Chemists' SocietyVolume 91, Issue 3, pp 363-384,2014
[45] Jian Wang, Sanjay Guleria, Mattheos AG Koffas, Yajun Yan, Microbial production of value-added nutraceuticalsCurrent Opinion in Biotechnology Volume 37, pp 97–104,2016
[46] Jimenez MA, Scarino ML, Vignolini F, Mengheri E. Evidence that polyunsaturated lecithin induces a reduction in plasma cholesterol level and favorable changes in lipoprotein composition in hypercholesterolemic rats. J Nutr 120pp:659–667,1990
[47] Kay RM. Dietary fibre. J Lipid Res. pp23:221–242 ,1982.
[48] Kip P, Meyer D, Jellema RH. Inulins improve sensoric and textural properties of low-fat yoghurts. Int Dairy J. ;16 pp:1098–1103 ,2006.

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[49] Kobayashi T, Shimizugawa T, Osakabe T, Watanabe S, Okuyama H (1997) A long-term feeding of sphingolipids affected the levels of plasma cholesterol and hepatic triacylglycerol but not tissue phospholipids and sphingolipids. Nutr Res 17pp111–114, 1997.
[50] Larrauri J. New approaches in the preparation of high dietary fibre powders from fruit by-products Trends Food Sci. Technol., 10), pp. 3–8 ,1999.
[51] Loke, W.M. Proudfoot,J.M. J.M. Hodgson,J.M. McKinley, A.J. Hime,N. Magat,M. Stocker,R. CroftK.D. Specific dietary polyphenols attenuate atherosclerosis in apolipoprotein e-knockout mice by alleviating inflammation and endothelial dysfunction Arterioscler. Thromb.Vasc. Biol., 30, pp. 749–757,2010).
[52] Mann JDietary carbohydrate: relationship to cardiovascular disease and disorders of carbohydrate metabolismEur. J. Clin. Nutr., 61, pp. 100–111, 2007.
[53] Mensink R P, Ebbing S, Lindhout M, Plat J and van Heugten M M A Effects of plant stanol esters supplied in low-fat yoghurt on serum lipids and lipoproteins, non-cholesterol sterols and fat soluble antioxidant concentrations. Atherosclerosis 160 pp205–213,2002.
[54] Messina M J Legumes and soybeans: overview of their nutritional profiles and health Effects. American Journal of Clinical Nutrition 70 pp 439–450,1999.
[55] Milner J A and Alison R G .The role of fat in child nutrition and development: summary of an ASNS workshop. Journal of Nutrition 129, pp 2094–2105,. 1999.
[56] Murphy P , Johnson L, White P, Galloway R (eds)" Soybean proteins.: chemistry, production, processing, and utilization. AOCS Press, Urbana, pp 229–269, 2008.
[57] Nestle M. Food politics: how the food industry influences nutrition and health .Univ. of California Press 2013
[58] Olivera A, Rivera J .Sphingolipids and the balancing of immune cell function: lessons from the mast cell. J Immunol 174,pp:1153–1158, 2005.
[59] Ostlund R E, Racette S B and Stenson W F Inhibition of cholesterol absorption by phytosterol-replete wheat germ compared with phytosterol-depleted wheat germ. American Journal of Clinical Nutrition 77 ,pp 1385–1389 , 2003.
[60] Pereira,M.A. O'Reilly,E. Augustsson,K. Fraser, G.E. Goldbourt,U.. Heitmann, G. Hallmans, P. Knekt, S. Liu, P. PietinenDietary fiber and risk of coronary heart disease: a pooled analysis of cohort studiesArch. Intern. Med., 164, pp. 370–376,2004.
[61] Record, I.R. Dreosti, I.E. McInerney J.KChanges in plasma antioxidant status following consumption of diets high or low in fruit and vegetables or following dietary supplementation with an antioxidant mixture Br. J. Nutr., 85, pp. 459–464, 2001
[62] Sajad Ahmad Wani , Pradyuman Kumar .Fenugreek: A review on its nutraceutical properties and utilization in various food products ,Journal of the Saudi Society of Agricultural Sciences Available online 27 January 2016
[63] Schmelz EM, Dillehay DL, Webb SK, Reiter A, Adams J, Merrill AH Jr Sphingomyelin consumption suppresses aberrant colonic crypt foci and increases the proportion of adenomas versus adenocarcinomas in CF1 mice treated with 1,2-dimethylhydrazine: implications for dietary sphingolipids and colon carcinogenesis. Cancer Res 56 ,pp:4936–4941,1996.
[64] Singh PK, Mann RS, Jha A Development of low fat fiber enriched ice cream – scope of entrepreneurship. Souvenir of the National Workshop on Entrepreneurship Development in Dairy and Food Industry held at National Dairy Research Institute, Karnal on 23rd December, 2005. pp: 84–88,2005.
[65] Staffolo MD, Bertola N, Martino M, Bevilacqua A. Influence of dietary fiber addition on sensory and rheological properties of yogurt. Int DairyJ;14:pp263–268, 2004.
[66] Sugano M Nutritional implications of soy. In: Sugano M (ed) Soy in health and disease prevention. CRC Press, Boca Raton, pp 1–16, 2006.
[67] Taşan M, Bilgin B, Geçgel Ü and Demirci A Ş Phytosterols as functional ingredients. Journal of Tekirdog Agricultural Faculty 3 153–159 , 2006.
[68] Trowell H, Burkitt D, Heaton K. Definitions of dietary fibre and fibre-depleted foods and disease. London: Academic; pp. 21–30 ,1985. .
[69] Tungland BC, Meyer D. Nondigestible oligo and polysaccharides (dietary fibre): their physiology and role in human health and food. Compr Rev Food Sci Food Saf. ;1, pp:73–92 ,2002 .
[70] VanDam, R. SeidellJ. Carbohydrate intake and obesityEur. J. Clin. Nutr., 61, pp. S75–S99,2007.
[71] Venn,B., MannJ. Cereal grains, legumes and diabetes. Eur. J. Clin. Nutr., 58, pp. 1443–1461,2004.
[72] Villegas B, Costell E. Flow behaviour of inulin-milk beverages. Influence of inulin average chain length and of milk fat content. Int Dairy J. ;17(7) pp:776–781,2007.
[73] Vincent A, Fitzpatrick LA) Soy isoflavones: are they useful in menopause? Mayo Clin Proc 75pp:1174–1184,2000.
[74] Wallace,T.C. Giusti M. Determination of color, pigment, and phenolic stability in yogurt systems colored with non acylated anthocyanins from Berberis boliviana L. as compared to other natural/synthetic colorantsJ. Food Sci., 73, pp. 241–248,2008.
[75] Wang T Minor constituents and phytochemicals of soybeans. In: Johnson L, White P, Galloway R (eds) Soybeans, chemistry, production, processing, and utilization. AOCS Press, Urbana, pp 297–331,2008.
[76] Weaver CM, Cheong JMK Soy isoflavones and bone health: the relationship is still unclear. J Nutr 135pp:1243–1247,2005.
Woyengo T A, Ramprasath V R and Jones P J H Anticancer effects of phytosterols. European Journal of Clinical Nutrition 63pp 813–820,2009