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Natural Food Additives: Application in functional food development

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Food is a most important basic need of everyone's lives. It gives us the energy and nutrients to grow and develop, be healthy and active.Many food products are perishable by natureand require protection until reach the consumer without affecting its quality.It can be done through controlled packaging, either under refrigeration, or the use of additives.A food additive is defined as any substances which are intentionally added to food to preserve flavor or enhance its taste, to improve the texture, appearance and other qualities etc. Functional foods can be developed with addition of specific componentsto enhance taste, texture, and flavor with health benefit for consumers. Functional foods have been named as bioactive foods, super foods, designed foods, foodceuticals, etc. It can be categorized into two groups which includes i) foods which are marketed with nutritional claims (eg. Fortified foods) ii) foods which are designed to enhance certain body functions for humanwell being (eg.Nutraceutical/therapeutical foods).Currently consumers has become more awareness of health benefit of additives from natural origin and tend touse in food products than additives from synthetic origin.However, these natural additives are not categorized in a well defined manner.As per the EU council regulation they are listed under "E" classification (Council Regulation (EC) 1129/2011). This manuscript highlights the details on most exploredadditives vizantioxidants, antimicrobials and colorants from natural origin used in food products. In addition to food additives derived from marine source and its applications also discussed

Natural antioxidant:

Antioxidants are substances that inhibit or delay oxidation by reacting with and neutralizing the free radicals.They are generally aromatic compounds that are phenolic in nature.Many of the phenolic compounds extracted from spices have been tested for its antioxidant activities. All these studies have revealed that majority of the antioxidant activity due to presence of polyphenol, terpenoidsand flavonoids.Details of natural antioxidants used in food products are given in Table 1.

Natural antimicrobials:

An antimicrobial agent is defined as a natural or synthetic substances that kills or inhibits the growth of microorganisms such as bacteria, fungi and algae. Numerous efforts are conducted to find natural antimicrobials to prevent bacterial and fungal growth in foods.To inhibit growth of undesirable microorganisms in food, the antimicrobials can be directly added into the product formulation, coated on its surface or incorporated into the packaging material. Direct incorporation of active agents into food results in an immediate but short-term reduction of bacterial populations, while the antimicrobial films can maintain their activity for a long period of time.Application of natural antimicrobials in food products are given in Table 2.

Food colorants:

Color is one of the most imposingcharacteristics of foodstuffs, which directly influences consumer's preference and acceptance.Apart from other food additives, natural food colorant has also received a particular attention to increase organoleptic features of food products.According to FDA, a food colorant is "any dye, pigment or substance which when added or applied to a food, drug orcosmetic, or to the human body, is capable (alone or through reactionswith other substances) of imparting color".It has been reported that natural food colorants to be a very effective,

Table 1.Natural antioxidants used in food products.

Antioxidant source	Active compound	Mode of action	Application
Spices and herbs	Phenolic acids and terpenoids	Reduce the rate of autoxidation	Sausage, pork product, mince based fish product, microencapsulation of fish oil
Fruits and leaves	Flavonoids and water-soluble vitamins	Reduce the rate of autoxidation	Fish and meat products
Nuts and seeds	Tocopherols and tocotrienols	Reduce the rate of autoxidation	Restructured meat products, fish products
Essential oils	Polyphenols	Reduce the rate of autoxidation	Meat products, functional fish products, microencapsulation of fish oil
Protein hydrolysates and Peptides	Peptide	Reduce the rate of autoxidation, metal ion chelator	Meat products, Surimi, ready to eat fish products, microencapsulation of fish oil

Table 2: Natural antimicrobials used in food products			
Natural antimicrobial source	**Main active compound**	**Mode of action**	**Food product**
Microorganism	Nisin (E234)	It has a widerange of action with respect to species	Coatings, Films, Dairy products, Beverages, Eggs
Microorganism	Natamycin (E235)	Activeagainst yeasts and moulds	Encapsulation, Films, Cheese, Beverages
Egg	Lysozyme (E1105)	Very high activity against Gram negativebacteria	Cheese, edible coating
Essential oils	Polyphenols, terpenoids (Not GRAS/No E number)	Antimicrobial activity	Meat, Fish and fish products, Dairy products, Vegetables, Rice, Fruit, packaging film

safe and providing health benefits as food ingredients as compared to chemicalorigin of food colorants Natural food colorants used in food products are given in Table 3.

Natural sweeteners:

Natural sweetenersare categorized in to two groups i) bulk sweeteners ii) high-potencysweeteners. The difference between the two groups is the first one has a one or less sucrosemolecule (sucrose is the international standard for sweetness),while the second one have a higher sucrose molecule.Natural sweeteners used in food products are listed in Table 4.

Food additivesderived from marine source and its applications

Protein hydrolysatederived from fish and shrimp used as additive in food products.It has been reported that peptide present in the hydrolysateact as antioxidant.It has been reported that

Table 3: Natural food colorants used in food products

Natural food color source	**Main active compound**	**Pigment color**	**Food product**
Seeds of the achiote tree (Bixaorellana	Annatto (E160b)	Orange-red	Dairy and bakery products, sausages, cereals, smoked fish, analogue fish products
Turmeric	Curcumin(E100)	Yellow	Dairy based products, bakery items,Salad dressings, fish products, processed meat
Red bell peppers (*capsicum annuum*)	Capsanthin or capsorubin, Paprika extract (E160c)	Deep red	Meat products, analogue fish products,Eggs, cheese,chicken pies
Tagetes spp. flowers, Scenedesmus sp. (microalgae) (Xantho phyllo myces dendrorhous (yeast)	Astaxanthin(E161j)	Red-orange	Nutraceutical food products
Female Insect (*Dactylopiuscoccus)*	Carminicacid and carmines (E120)	Red	Jelly type products, Dairy and Bakery products, Non-carbonated drinks, meat products
Daucuscarota L. roots, Blakesleatrispora (fungus	Carotene b-Carotene(E160a)	Red-orange	Milk and bakery products,soft drinks
Hylocereuspolyrhizus (Weber) Britton & Rose fruits	Betacyanins(E162)	red-purple	Dairy products, sweets, soups, sauces, Burgers, desserts, jams, jellies
Beta vulgaris L. roots	Betalains (E162)		
Acacia decurrensWilld. Bark, Ajugareptans L. flowers, Brassica oleracea L. leaves, Grape skin, red cabbage	Anthocyanin derived extracts (E163)	Depending on their pH, may appear red, purple, blue or black.	Dairy products, Beverages, sauces, candies, chewing gums.

Table 4: Natural sweeteners used in food products

Natural sweeteners source	Main active compound	Food product
Fruits andvegetables,Osmophilic yeasts or fungi	Erythritol (E 968)	Bakery products, candy, low-calorie beverages, candy and chewinggums,
Fruits and heat treated dairyproducts	Tagatose	Milk product, candy, chewing gum and beverages
Plant,*Stevia rebaudiana*	steviol glycosides (E 960)	Milk products, beverages, frozen desserts, sauces, dried fish products
Glycyrrhizaglabra L., theliquorice plant.	Glycyrrhizin (E 958)	Bakery and dairy products, beverages, confectioneryitems
Plant,*Thaumatococcusdaniellii*	Thaumatin(E 957)	Fruit juice, soups, sauces, egg and chicken based products, chewing gum and processed vegetables

hydrolysate could reduce or slow down the autoxidation in food products. Moreover fish protein hydrolysates possess various functional properties such as water holding capacity, fat absorption capacity, good solubility, emulsion andfoaming capacity which makes its as functional ingredients in various food products. Major food application of fish protein hydrolysates (FPH) are cereal based products, ready to eat fish product, fish mince and surimi based products, meat products and desserts etc.

Fish gelatin is extracted from the collagen of fish skin and it is an important functional biopolymer that has broad applications in the food, pharmacy and photography industries. Gelatin has also been extensively studied for its film forming capacity and applicability as an outer covering to protect food against drying,light and oxygen.

Collagen is the most abundant structural protein and it has a recognised position as functional ingredient and identified as health promoting properties.To take advantages of all these healthy effects there is an increasing number of dietary supplements containing marine collagen on the health market with different presentations such as tablets, capsules, powder drink mixes, syrups, creams, bars, etc.

Fish bone is considered as a potential source of calcium.The calcium rich fish bone powder could be used for the fortification of fish products such as surimi.

The omega -3 fatty acids plays a major role in human health and prevention of wide range of diseases via its positive effect on the brain, heart and nervous system. Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) commonly referred omega-3 fatty acids which is most frequently found in fish. Incorporation of fish oil rich omega-3 fatty acids into food system is very challenging one due to is unsaturated nature. Microencapsulation of fish oil will solve these issues. Microencapsulated omega -3 fatty acids have been successfully incorporated in to wide range of food products viz. bakery and pasta products, yogurt, juices, sauces and infant formulas.

Chitosan is yet another natural polymer obtained by deacetylation of chitin from crustacean shell waste.It has been identified as a valuablecomponent for producing biodegradable films because of its filmforming ability, antioxidant and antimicrobial properties. Chitosan and its derivatives also used as functional food ingredient.

Conclusion

The demand for healthy food products is increasing worldwide by the consumer. Today foods are not intended only to fulfill hunger and to provide essential nutrients for humans. Application of additives from natural source gets more importance in food product development and most of the research studies also highlighted their potential to replace synthetic additives to prevent oxidation and quality deterioration in food, texture modification etc. Hence, the additives from natural source have wide scope for functional food development in food industry.