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Fat Replacers-An Overview

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ABSTRACT
Fat plays a key role in a majority of food products. It is an important constituent of food and serves as a rich source of energy and contributes to various sensory and rheological characteristics. It provides a creamy texture and a flowing mouth feel to foods. These attributes contribute to richness of the food resulting in better market value. The consumption of diet, high in fat is associated with excess calorie intake resulting in overweight and obesity which is cause for increased risk of cardiovascular disease, type 2 diabetes mellitus and some cancers. Hence there is demand for low-fat and low energy foods. Snack foods, is one of the key contributors to excess calorie intake and therefore weight Consumers are looking for healthy snacks low in fat or free from fat. Therefore, great effort has been made to reduce the fat from food formulations without affecting their flavour and texture. Fat replacers are substances that can be used in different foods to mimic the textural and sensory attributes provided by fat, but give considerably lower amount of calories and may be used to replace some or all of the fat in food products. In this review we summarize the effect of fat replacers on quality of food products and their effects on health.
***Key Words**: Fat, Snack foods, overweight, fat replacers*

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INTRODUCTION

According to the Academy of Nutrition and Dietetics, Fat replacers are ingredients that can be used to provide partial or complete functions of the fat yielding fewer calories than fat.

Fat replacers are the substances, which chemically resemble fats, proteins or carbohydrates and possess certain desirable physical or organoleptic properties of fat. Fat replacers serve two purposes. They reduce the amount of fat in food, and they usually reduce the calorie content of the food with no change in texture and taste of food (1,4).

Fat replacers are categorized in two groups, i.e., Fat substitutes and Fat mimetic.Fat substitutes can directly replace conventional fat molecules in foods on a weight-for-weight basis. They are generally heat stable and suitable for high temperature cooking and frying applications and fat mimetics are substances which can mimic some of the organoleptic and physical properties of conventional fat molecules. However, they cannot replace fat molecules in food on a weight-for-weight basis(4,10).

The consumption of diet, high in fat is associated with excess calorie intake resulting in overweight and obesity which is cause for increased risk of cardiovascular disease, type 2 diabetes mellitus and some cancers (1,8).

Fat Replacers are grouped based on their chemical nature as Protein based, Carbohydrate based and Fat based/Synthetic fat replacers (3,4).

CLASSIFICATION OF FAT REPLACERS

1.1 .Protein-Based Fat Replacers

Protein-based FR is derived from Milk (whey protein) , egg protein and other foods These proteins are produced by microparticulation process. which involves heating and blending protein at high temperature to develop microscopic particles that are said to float over tongue to provide creamy mouth feel of fat (3).

1.1.1Simplesse (NutraSweet Kelco Co.) is a microparticulated protein-based fat mimetic Microparticulated protein (marketed under the brand names Simplesse and Trailblazer) is madefrom microparticulated milk or egg-white proteins, sugar, pectin, and citric acid. process. which involves heating and blending protein at high temperature to develop microscopic particles that are said to float over tongue to provide creamy mouth feel of fat ,butlack in fat-type flavor. As microparticulated protein

fat replacers are not heat-stable, they are used chiefly in cold products such as ice cream, butter, margarine, sour cream, and salad dressings. The protein based fat replacers cannot be used in fried and baked products as the protein coagulates and loose creaminess. Microparticulated protein fat replacers provide 1.33 calories per gram, as compared with the nine calories per gram of regular fats. when used in ice cream, a single gram of simplesse can replace three grams of fat, thus saving 23 calories.Simplesse was given GRAS status in 1990 for use in frozen desserts and in 1994 for use in yogurt, cheese spreads, frozen desserts, cream cheese, and sour cream. Simplesse cannot be used in high-temperature food applications, which could easily denature the proteins. On a dry basis Simplesse provides 4kcal/g, whereas a hydrated gel provides 1 kcal/g (1,10).

1.1.2 Modified whey protein (marketed as Dairy-Lo) is made from high quality whey (or milk) protein concentrate. Modified whey protein improves the texture, flavor, and stability of low-fat foods. It replaces fat at four calories per gram and is typically used in frozen dairy desserts, cheeses, yogurts, sauces in baked goods. It has ability to prevent iciness in frozen foods .(10).

1.1.3 Isolated soy protein (marketed as Supro, ProPlus, and Supro Plus) are used by the manufacturers to reduce the fat content of foods-primarily meat products. Isolated soy protein is also used in some beverages and in weight-loss products.(10).

1.2 Carbohydrate-Based Fat Replacers

These fat replacers incorporate water into a gel-type structure, resulting in lubrication and flow properties similar to that of fat. Carbohydrate-based Fat replacers are categorized into starch-derived, cellulose-based, fiber-based, gum-based, and others.(3).

1.2.1Starch-derived Fat Replacers

Starch based fat replacers are used either as modified starch or maltodextrins .These are made from starchy foods such as maize, rice, wheat,potato and others Resistant Starch is generally used as anfat replacer in baked goods, extruded snacks, pasta, breakfast cereals and beverages.

1.2.2Maltodextrinis obtained by the hydrolysis of starch into glucose syrup.It is the percentage of total solids that have been converted into reducing sugars. Maltodextrins are used as anfat replacers in dairy products, confectionary, frozen desserts, cereal baked goods and meat products due to their ability to form soft, spreadable, thermoreversible gels with melt-in-the-mouth properties(3,10).

1.2.3 Polydextrose

Polydextrose is a synthetic low-calorie carbohydrate, a polysaccharide composed of D-glucose (dextrose) and sorbitol, which are derived from corn-starch and citric or phosphoric acidPolydextrose is a soluble fiber .Polydextrose exists in powder form. Polydextrose is used as a low-calorie bulking agent that can replace all or part of the sugars and some of the fats in foods while maintaining a pleasant texture and mouth feel(3,10).

1.2.4 Cellulose derivatives

The most widely available cellulose-based FR are microcrystalline cellulose (MCC) and methylcellulose (MC) These are used to stabilize foams and emulsions, modify texture, increase viscosity, and add dietary fiber. s an insoluble, non-digestible fiber. It is often used in fried foods and bakery products. Like most carbohydrate-based fat replacers, powdered cellulose binds water tightly. Thus, when powdered cellulose is used in the batter of foods to be fried, the cellulose preferentially binds to water instead of to the oil used in frying. The end result is that less of the oil is absorbed by the food as it is fried(10).

1.2.5 Gums

Hydrophilic colloids include xanthan gum,guar gum,locust bean gum, gum Arabic and carrageenan. They provide thickening effect, creamy texture and also useful

as a protective agent against cardiovascular diseases, diverticulitis, constipation, irritable colon, colon cancer, and diabetes(3).

1.2.6 Dietary fibre based Fat replacers

Z-trim

It is made from the processed hulls of oats, soybeans, peas, and rice or from the bran of corn or wheat. The hulls or bran are processed into microscopic fragments, which are then purified, dried, and milled into a powder. The fragments absorb water, they swell thus provide the smooth mouthfeel of fat. Z-trim passes virtually unmetabolized through the human body, so it contributes no calories. No adverse gastrointestinal side effects have been noted from the consumption of Ztrim containing products (3,10).

Oatrim

Oatrim is enzymatically modified (hydrolyzed) oat flour containing amylodextrins and approximately 5 % of ß-glucan as soluble fiber uses as fat replacers in many of food products. (3,8)

Inulin

Inulin is a soluble fiber contaning oligosaccharides found in chicory roots. Due to high water binding capacity it forms a creamy gel, and can easily be used as a fat substitute in food products (3,8).

1.3 Fat-Based Fat replacers /Synthetic Fat Replacers

Generally structured lipids are triacylglycerols (TAGs) that have been modified to change in the fatty acid composition and/or their positional distribution in glycerol backbone by chemically and/or enzymatically catalyzed reactions and/or genetic engineering. These are produced by replacing the fatty acids in the triglycerides Other fat replacers are based on the fact that level of 9 kcal per gm does not apply when short chain fatty acids are present and also long chain stearic acid are incompletely metabolized and yield calorie value less than 9 kcal/g. By combining these two types of fatty acids into glycerides fats are obtained that have energy values of 5 kcal per gm. Structured lipids thus provide an effective means for producing tailor-made lipids with desired physical characteristics, chemical properties, and/or nutritional benefits.

Fat-like substances, which are resistant to hydrolysis by digestive enzymes, comprise another major category of fat replacers. These can be used as partial or full replacements for oils and fats in bakery and other food products(3,7).

1.3.1Olestra (marketed under the name Olean), is the first calorie free fat substitute approved by the U.S. Food and Drug Administration Olestra is a sucrose polyester with 6 to 8 acyl groups derived from soybean,corn, cotton seed or sunflower fatty acids.It is not absorbed in the digestive system because it is not hydrolyzed by pancreatic lipase and yields no calories.
(3,5,10).

1.3.2 Salatrimis the name for a family of reduced-calorie fats typically made from soybean or canola oil. (The name "salatrim" stands for short and long chain acid triglyceride molecules) Salatrim provides just five calories per gram, rather than the typical nine of regular fats. Salatrim can be used to reduce the fat in a variety of products such as baked goods, confections and dairy products. Unlike olestra, salatrim cannot be used for frying. (3,10)

1.3.3EPG (Esterified propoxylated glycerol) has appearance tastes and functions like fat because it is made from is made from plant based oil. It contains 0.7 calories per gram and allows for up to 45% caloric reduction in applications. EPG has GRAS approval include snack foods; plant-based protein products, beverages such as coffee and tea and dairy product analogs(3,12).

EFFECT OF FAT REPLACERS ON QUALITY OF PRODUCTS

2..1 The fat replacers significantly influenced the meltability of low-fat 6 percent fat Mozzarella cheese. Cheese made with Stellar (carbohydrate based) and Simplesse (protein based) had greater overall meltability than those made with Dairy-Lo (protein based) or the control (without fat replacer) (9).

2.2 Carragennan is used as gelling agent used in the food industry. The gel strengthening properties of carragennan are as a result of strong bonds formation with casein protein.However, carragennan-casein interaction is dependent on pH.The correct concentration of carragennan and temperature treatment can improve cheese yield and whey protein recovery, which is desirable for cheese producers.A small amounts of this carragennan is found to increase cheese firmness and maintain cheese structure after cheese curdheating. Carragennan improves other properties, such as ease of gratingor slicing. Carragennan can be a good replacement for emulsifying salts, to stabilize cheese fat without disturbing the Ca:P ratio. The replacement of emulsifying salts with carragennan (as little as 1%) results ina homogenous cheese product. For that reason, carragennan is a useful additive for maintaining the organoleptic and structural values of fat-free cheese(2).

2.3 Inulin as a fat replacer at different levels (2, 3, and 4%) in low-fat ice cream containing 2% fat decreased the hardness compared with the low-fat ice cream Inulin improves the consistency of low fat ice-cream mix due to its gelling properties, which consequently can reduce rate of ice crystallization(11).

2.4 Oatrim was the most successful fat replacer in biscuits which was able to retain most
sensory properties of a traditional biscuit and cakes even at 50-100% FR, although there was a significant changes in physical properties

Inulin was found to be the most successful fat replacer in legume crackers, reaching an acceptable level of FR at 75%. The additional benefits of using inulin is high fibre content that increases the market valueof it(8).

SAFETY OF FAT REPLACERS

The use of fat replacers to reduce the fat content in food products also raises the concern of consumers safety. The safety of the currently used fat replacers is ensured by the GRAS status by the FDA.

Many of the carbohydrate-based, protein-based, and fat-based fat replacers have not shown major health concerns except for Polydextrose and Olestra. Polydextrose can have a laxative effect and Olestra may cause leaky and fatty stools and loss of fat soluble vitamins. As a part of healthy dietary pattern, fat substitutes, when used judiciously, may provide some flexibility in diet planning, although additional

research is needed to study the safe use of these products by children and adults, tofully determine the longer-term health effects. and the potential interaction with food ingredients and drugs. No single fat replacer can provide all attributes of fat. So solution to this is combination of fat replacers for their cumulative effect. There is a need to develop fat replacer, which can be used in a number of food products with no effect on sensory quality and health(3,6).

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