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# POSSIBILITIES TO DEVELOP LOW-FAT PRODUCTS: A REVIEW

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**Abstract:** Research has proved a relationship between high fat consumption and rise in obesity, atherosclerosis, coronary heart diseases and high blood pressure. Therefore is recommended the moderate consumption of fat, such that the total fat does not exceed 30% of total energy intake. Our body needs fats because are providers of calories, essential fatty acids, fat-soluble vitamins and also they are necessary ingredients of the foods. The development of products with low-fat content can be considerate a challenge because the lipids offers aroma, texture, appearance, flavour and mouth feel, qualities that customers want in food products. A fat reduction can be achieved by using different fat replacers to ensure the functionality of the replaced fat. Functional components of fat replacers can have a significant role in promotion of wellbeing, in treating and preventing diseases. Thus, fat replacers should be recognized as safe and healthy, which have sensorial and functional properties. This paper reviews the fat replacers used to obtain foods as meat-based or dairy products. Some ways to obtain healthier meat products by reducing saturated fats content consist in the utilization of unsaturated vegetable oils, vegetable products, fibre. The utilization of fibre in products such bolognas, sausages or hamburgers, can improve the texture profile, binding properties and the characteristics regarding the cooking process. A fat reduction in dairy products can be achieved by replacing it with starches, polysaccharides, gums or fibres from cereal, vegetables and fruits. In acidified milk products, fibres have benefits as: low syneresis, sensory characteristics accepted by consumers, improvement of texture and rheological properties. In cheeses production, the fat reduction can be realised by replacing it with carbohydrate or protein-based replacers in order to obtain a final product with proper characteristics.

**Keywords:** fat, health, fat substitutes, fat mimetics

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## INTRODUCTION

Foodstuffs represent important vehicles for humans, providing the essential nutrients that can maintain or improve their health (Hygreeva et al., 2014). Nowadays people are interested in foods with bioactive components which provide health benefits (Cofrades et al., 2008).
In foods, an essential component is fat with roles in development of flavour, texture, juiciness and appearance (Akin et al., 2015), (Choi et al., 2010). Lipids are also responsible in product processing for cooking yield and water holding capacity (Choi et al., 2013).
Fat provides a considerable amount of energy (9 kcal/g), is a source of essential fatty acids and is important for maintaining a healthy skin (Akoh, 1998).
Fats are vital macronutrients that keep the body healthy. Moderate fat intake is beneficial, but higher quantities of fats can determine serious complications (Siraj et al., 2015). Health organizations recommend that from total energy intake, the total fat be less than 30% (Hooper et al., 2012), (WHO, 2003), (FAO, 2010). Also, nutritional guidelines suggest that that saturated fat should be less than 10% of caloric intake and be replaced with unsaturated and trans fats should be eliminated (WHO, 2003), (FAO, 2010), (Nishida et al., 2009).
The rise in obesity, atherosclerosis, coronary heart disease, high blood pressure is observed in recent decades because of high fat consumption (Madadlou et al., 2005). As a result, reducing fat in the daily diet has become a concern for consumers, causing an increase in the demand for reduced fat foods (Martínez-Cervera, 2011), (Chugh, 2015).
Reducing the fat content from foods causes negative impact on texture, flavour and appearance (Miles, 1996), (Romeih et al. 2002). With the aim to improve the quality characteristics of low-fat products are used fully or partially fat replacers (Akoh, 1998). They are classified as lipid substitutes and as lipid mimetics (Romeih et al. 2002). Fat substitutes can theoretically replace the fat one to one in food products (lipid- or fat-based fat replacers). Fat imitators are substances with similar properties of triglycerides, but which cannot replace fat gram-for-gram and they are called fat replacers based on proteins or carbohydrates (Romeih et al. 2002), (Akoh, 1998).
This paper reviews the ways to reduce fat content in meat products, the use of fibres as fat replacers and the ways to reduce fat content in dairy products.

## 1. **Ways to reduce fat content in meat products**

A healthy diet should include meat and meat products, because are important components due to their characteristics such as source of high-quality

protein, B-group vitamins and essential fatty acids. (Biesalski, 2005), (Rodríguez-Carpena et al, 2012). After several studies regarding the connection between meat intake and higher risk of certain diseases, it could be concluded that there is a relationship between consumption of animal fats (particularly saturated fat) and increased risk of some disorders such as coronary-heart diseases and colorectal cancer (Carpena et al, 2012), (Ferguson, 2010).

Because in general in meat products the fat has high quantity of saturated fatty acids and cholesterol, in the processed meat industry the substitution of saturated fat is problematic (Hygreeva et al., 2014), (Siraj et al., 2015). Due to their fatty acid composition and lower melting temperature, saturated fats have an essential role regarding the texture, juiciness, mouth feel and general product acceptance by consumers (Siraj et al., 2015). The recommendations to increase consumption of beneficial fats, led to the production of meat products with health benefits (Hygreeva et al., 2014).

A major drawback is that meat products with reduced fat content tend to be firmer, rubberised and less succulent, with an unpleasant dark colour. Other unfavourable issues in the development of meat products with lower fat content consist in reduced cooking yields, rubbery skin formation, fat and moisture loss, which represent important qualitative characteristics for the consumers. The development of meat products with low-fat content is usually accomplished by using raw material that have the property to bind water, thus being overtaken the high dry matter content, rubberiness and being improved the juiciness (Tabarestani and Tehrani, 2014).

A way to obtain a healthier lipid content in meat products through reduce saturated fats content is the utilization of unsaturated vegetable oils, which improve the fatty acid profiles in meat products and also helps in product stability (Hygreeva et al., 2014), (Siraj et al., 2015).

Ingredients such as vegetable oils and natural extracts, vegetable products and fibre was used as in products based on meat for the improvement of functional properties (Pelser et al., 2007), (Vural, 2003), (Valencia et al, 2008), (Serdaroglu and Degirmencioglu, 2004), (Turhan et al., 2007), (Jo et al., 2003), (Turhan et al., 2005). Imaijumi et al., (2000) reported that oils rich in linoleic acid have benefits in reducing serum cholesterol levels.

Meat products with low fat content, obtained by many researchers are presented in Table 1.

## Fibres as fat replacers

The diseases occurrence (gastrointestinal, obesity, diabetes, hypertension) can be reduced through consumption of dietary fibre (Anderson et al., 2009).

Table 1. Fat replacers in healthier meat products adapted from Hygreeva et al. (2014)

| Fat replacers | Product | Reference |
|---|---|---|
| Flax seed oil<br>Canola oil | Fermented sausages | Pelser et al., 2007 |
| Palm oil<br>Cotton seed oil<br>Olive oil | Frankfurters | Vural et al., 2002;<br>Vural et al., 2004 |
| Poppy seeds | Beef burgers | Gok et al., 2011 |
| Olive oil<br>Flax seed oil<br>Fish oil<br>Konjac gel | Liver meatballs | Delgado-Pando et al., 2011 |
| Soy flour<br>Pea flour<br>Wheat starch | Hamburgers | Tabarestani and Tehrani, 2014 |
| Linseed oil<br>Fish oil | Raw sausages | Valencia et al., 2008 |
| Canola oil<br>Canola-olive oils | Frankfurters | Álvarez et al., 2012 |
| Wallnut (20%) | Restructured beef steaks | Serrano et al., 2005 |
| Wallnut (25%) | Frankfurters | Ayo et al., 2007 |
| Wallnut paste 15, 30, 45% | Turkish sucuk | Ercoskun et al., 2010 |
| Olive oil 60% | Dry, spicy sausage | Kayaardi et al., 2004 |
| Lin seed oil 6.6% | Dry fermented sausages | Ansorena and Astiasaran, 2004 |
| Soy oil 15, 20, 25% | Fermented sausages | Muguerza et al., 2003 |
| Olive oil emulsified alginate | Sausages | Beriain et al., 2011 |
| Oat flour | Chicken nuggets | Santhi and Kalaikannan, 2011 |
| Fibre pectin from tomato pomace | Beef burger | Namir et al., 2015 |
| Cashew apple residue | Hamburgers | Pinho et al., 2010 |

In meat products, fibres decrease the caloric content, increase the carbohydrate content and therefore may be regarded as functional ingredients (Hygreeva et al., 2014).

Plant dietary fibres have been successfully utilized as partial fat mimetics in many studies, and was concluded that utilization of fibre for obtaining meat products can improve the binding properties, textural characteristics and cooking yield (Borderías et al., 2005), (Fernandez-Ginés et al., 2004).

Choi et al. (2010) have replaced the pork fat back with grape seed oil and rice bran fibre. Their conclusion was that through utilization of these two

replacers, besides the fact that it can reduces the amount of saturated fat, also it can improve the characteristics regarding the cooking process.
The utilization of different concentrations of lemon albedo in sausages improved the nutritional value of the final product (Fernandez-Ginés et al., 2004).
Pietrasik and Janz (2010) have produced low fat bolognas with fibre, pea starch and wheat flour. Yang et al. 2007 developed sausages with reduced fat content by adding oat meal or tofu at different concentrations and they discovered that utilization of oatmeal previously hydrated took part in increasing the water holding capacity, the cooking yield and have helped at the obtaining of a product with softer texture.
Huang et al. (2005) reported that addition of rice bran (< 10 %) with different particle sizes to meatballs, may be an optimal option for obtaining products with low fat content, but a major drawback is represented by the grinding manner of the bran, because the dimension of the particles have negatively influenced the characteristics of the final product.
Garcia et al. (2002) added cereal (1.5%) and fruit fibres (3%) in reduced fat dry fermented sausages and observed that utilization of fruit fibre (1.5%) along with pork fat (10%) have led to a proper texture profile and better sensory acceptability.
Sayago-Ayerdi et al. (2009) have observed that through utilization of grape fibre improved the oxidative stability and radical scavenging activity in hamburgers obtained from chicken meat.

## 2. **Ways to reduce fat content in dairy products**

Currently, the tendency to consume low fat foods has grown up, even if the fat has significant impact over their physical, rheological and textural properties, microbiological stability. Thus for this purpose, to produce qualitative dairy products, are used fat mimetics, which bring a lower caloric value, ensure the same physical and sensorial characteristics in the final product (Bom Frost et al, 2001), (Jonnalagadda et al, 2005).
The production of low-fat dairy products is not an easy task. For example, acidified milk products with low fat content are harder accepted by consumers because of the undesired rheological properties and the high syneresis, while the problems at low-fat cheese are flavour and rubbery and hard texture. A fat reduction can be achieved by replacing it with carbohydrate-based fat replacers to ensure the functionality of the replaced fat. Also we can develop yoghurt by partially replacing the lipid with sodium caseinate, whey protein concentrates, or by incorporate other raw materials such as starches (Cais-Sokolinska et al., 2006), (Oh et al., 2007), (Soukoulis et al., 2007). Also, polysaccharides and gums are utilised for their properties

to improve the texture and consistency by changing the rheological characteristics of dairy products (Everett and McLeod, 2005), (Kip et al., 2006), (Fagan et al., 2006), (Brennan and Tudorica, 2008), (Guggisberg et al., 2009). Brennan and Tudorica, 2008) have utilized dietary fibres as thickeners and stabilizers to produce sauces and dressing assortments, but they can be also added as fat replacers in a variety of products. Foods with higher fibre content offer a feeling of fullness and ensure more nutrients with few calories (Whelan et al., 2006), (Lyly et al., 2009).

Until now a series of studies have been made regarding the utilization of fibres from cereal, vegetables and fruits in yogurt (Dello Staffolo et al., 2004), (Aportela-Palacios et al., 2005), (Garcia-Perez et al., 2006), (Hashim et al., 2009), (Sendra et al., 2008), (Sendra et al., 2010). In acidified milk products, fibres have benefits as: improving texture and firmness, low syneresis and provide sensory characteristics that are accepted by consumers (McCann et al., 2011).

Brennan and Tudorica (2008) used barley beta-glucan, partially hydrolysed guar gum and inulin in the development of low-fat yogurts. For the improvement of viscoelastic nature and textural properties of the product were used 0.5% beta-glucan, and also inulin and guar gum at concentrations above 2%. Analyses performed on the samples demonstrate that the utilization of these replacers could be effectively utilized to develop low fat products, by reducing the syneresis of product, the improvement of the texture and rheological properties (Brennan and Tudorica, 2008).

The utilization of natural cell wall materials in food products provides several benefits. They help maintain health and they have characteristics such as water holding capacity and rheological characteristics, which places them among the 'clean-label' ingredients in food products (Harris & Smith, 2006). Cell wall particles are obtained from vegetables and fruits by the use of thermal and mechanical shear processes. Most often, these are obtained from by-products, with other processes conducted to minimize the particle dimension (Figuerola et al., 2005), (Chantaro et al., 2008), (Redgwell et al., 2008), (Day et al., 2010b), (Gupta and Premavalli, 2010).

Low-fat cheese varieties are usually characterized by rubbery texture, less flavour, low meltability and undesirable color (Mistry, 2001). The effects of Simplesse® D-100 and Novagel™ NC-200 (commercial hydrocolloid fat) on the characteristics of low-fat white brined cheese were investigated by Romeih et al. (2002). These fat replacers determined an increase in moisture content and cheese yield leading to an improvement of texture.

Other researchers reported that the texture of low fat Iranian white brined cheese was improved by adding gum tragacanth (Rahimi et al., 2007), or low fat paneer with superior quality were produced by incorporating 0.2 % soy protein isolate as the fat replacer (Kumar et al., 2011).

Starch is one of the most frequently ingredients used as fat mimetic, in food because it is relatively inexpensive and readily available (O'Connor and O'Brien, 2011). Waxy maize starch is a promising starch that can be considered for food applications, due to its unique composition (only traces of amylose) and its many specific attributes: easy swelling, hardly retrogrades, provides a sticky texture and offers better digestibility than do normal starches (Wang et al., 2010). The starch hidrolysates as maltodextrins are also taken into considerations as fat replacers as at the obtaining of ice cream (Roland et al., 1999): they have the advantage of possibility to obtain in a controlled way (Mironescu and Mironescu, 2011, 2012).

Totosaus and Guemes-Vera (2008) studied the role of κ- and λ-carrageenan incorporated in low fat Oaxaca cheese, a typical pasta filata assortment of cheese (like mozzarella) (Van Hekken and Farke, 2003). The impact of introducing k - and λ -carrageenans in Oaxaca cheese with low fat content regarding the melting process, color, protein, moisture, and yielding was determined. The fat content affected mainly the melting, but k –carrageenan improved this characteristic. Also, the reduction of fat content has affected the colour. It was shown that the utilization of low quantities of carrageenan has allowed the obtaining of Oaxaca cheese with significant fat reduction with an acceptable overall quality (Totosaus and Guemes-Vera, 2008).

Ertekin and Guzel-Seydim (2009) produced non-fat kefir adding Dairy Lo® and inulin, which did not have adverse effect on the properties of the product. Samples obtained with Dairy Lo® and inulin presented higher viscosity compared to the kefir produced without fat replacers. All kefir samples are identified as non-Newtonian pseudoplastic fluids with thixotropy. The conclusion of this research was that fat replacers could be added to develop milk products with low fat content, without negative effects.

Sahan et al. (2008) evaluated the quality of low-fat Kashar cheese obtained with: Simplesse® D-100, Avicel Plus® CM 2159 and β-glucan. Kashar cheese is one of the most popular cheeses in Turkey from the category of pasta-filata cheese.

Low-fat Beyaz cheeses were manufactured using as raw materials: ewe's milk, Simplesse® (protein-based replacer), Maltrin® (carbohydrate-based fat replacer) and a blend of both. The cheeses produced with Simplesse® were similar to cheese without replacers and obtained the highest sensory acceptance (Akin, 2015)

A non-fat goats' milk yogurt was obtained by adding heat-treated whey protein concentrate (HWPC) as a fat mimetic and pectin as a thickening substance. The results showed that the non-fat goats' milk yogurt made with 1.2% HWPC and 0.35% pectin presented higher viscosity compared to the other yogurts. Also this sample has registered a smaller syneresis than the yogurt obtained only with pectin. Throughout storage, viscosity and pH value

of yogurt did not shown significant change. Following this research was concluded that heat-treated whey protein concentrate could be used as a fat replacer for non-fat yogurt assortments and other similar products (Zhang et al., 2015).

## CONCLUSIONS

Consumer awareness of the health benefits of low-fat diets consumption is in constantly growing, but many of them are not accustomed to give up the taste, the texture and aroma in exchange of the products with health benefits. Thus, the challenge facing the food industry is to develop a variety of low-fat foods, with quality characteristics that are not impaired. Some fat replacers are important sources of bioactive components (vitamins, minerals, antioxidants) and their utilization may improve foodstuff quality and may support the food industry to achieve the objective to provide low-fat healthy products for consumers.

All research presented are intended to provide a positive image on obtaining products with low fat content and to emphasize that for developing these foodstuff should be considered a variety of factors. Further research must to be carried out in order to obtain products with health benefits, secure and shelf stable.

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