Development of Low Fat Meat Products

Heena Jalal *, Salahuddin Mir, Sarfaraz A. Wani, Asif Hassan Sofi, M. Ashraf Pal, Feroz Rather

Division of Livestock Products Technology, Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, India

* Author to whom correspondence should be addressed; E-Mail: drhennajalal@rediffmail.com; Tel.: +91-9906472031.

Abstract: Reducing the total fat content of processed meats is not only desirable but feasible. Combinations of different fat substitutes can reduce significantly the caloric content and the level of saturated fats. This could result in a new category of products which have an acceptable taste and a high degree of nutritional merit and offer the consumer an alternative to traditional processed products. These products must, however, deliver improved eating quality and contain reduced fat content at no or minimal extra cost. With these changes in mind, this article presents a review of novel ingredient systems and processing approaches that are emerging to create high quality, affordable low fat meat products.

Keywords: fat; obesity; low fat; meat products; fat replacers.

1. Introduction

The proposed relationships between high cholesterol level and low polyunsaturated/saturated fatty acids (PUFA/SFA) ratio and the rise in coronary heart diseases have resulted in focusing on low fat food products including some meat products (Giese, 1992). Researchers have been working on strategies to reduce animal fat usage in meat products. Thus, there is an expanding new category of products that acquire added nutritional value as a result of a significant reduction in their fat and
calorie content, and in their saturated fat and cholesterol levels. In recent years, there has been strong sales growth in fat-free food products, including various meat items. By definition, fat-free products must contain less than 0.5 g fat per serving based on lipid fatty acids expressed as triglycerides (USDA, 1995). To succeed in producing low-fat, healthy and palatable food products, other ingredients must be chosen to replace fat. These ingredients must replace the flavor and mouth-feel that would normally be derived from fat. Meat products with low fat must be perceived by consumers as healthy, a good economic value, and have desired palatability (Mandigo and Eilert, 1993). Reducing fat in processed meat products can be accomplished by using leaner meats and by the dilution of the fat, adding water and other non-meat ingredients (Mandigo, 1991). A major concern with adding water to meat products is increased cooking losses and purge (Gregg et al., 1993). In developing low-fat products, it is important to find the proper combinations of added water and reduced fat to benefit specific properties, without altering other characteristics (Claus et al., 1989).

2. Low-fat Formulations

Presently, consumers are very concerned about their diet and the food they eat. With the demand for nutritious and healthy food products, processed meat producers have to focus their attention toward processed meats that are lean, low fat and high in protein content. Health concerns about fat utilization and changes in consumer’s preferences have led to comprehensive research on low-fat foods (Yang et al., 2007). The demand for low-fat meat products has greatly increased in recent years as high fat intake, especially saturated fats, is associated with increased risk of chronic diseases of the circulatory system and some other types of cancers (AHA, 1996). Modern consumers tend to have great concern for their health and avoid foods that are high in fat, including processed meat products that may contain up to 30% fat. Previously, low-fat meat products were manufactured only for the purpose of diet foods for losing weight, but that focus has now been extended to health-conscious consumers (Yoo et al., 2007). Limitation in fat intake is thought to play a preventive role against various chronic disorders, such as obesity, coronary heart diseases and some types of cancers (Reddy, 1995). Nutritional guidelines suggest that dietary fat should provide between 15 and 30% of total calories, and saturated fats should be limited between 0 and 10% of calorie intake (WHO, 1990). Developing low-fat meat product which confirms to the dietary recommendation is difficult task (Giese, 1992). The development of low-fat products requires modifications to the products which can affect important quality attributes and therefore, consumer acceptability of such products (Jimenez et al., 1995). The development of low-fat product means that factors associated with meat raw materials, non-meat ingredients and manufacture and preparation procedures together with other factors such as the characteristics of the new derivative must be taken into account (Jimenez, 1996). The palatability
and acceptability of meat products are directly related to the fat content (Pearson and Gillet, 1997). The production of low-fat products through simple fat reduction would substantially reduce product palatability, juiciness, tenderness and flavor intensity (Kregel et al., 1986). Fat reduction in meat products without additives may decrease palatability (Trout et al., 1992a). Ground beef is less palatable and satisfying when fat decreases (Berry and Leddy, 1984), especially when fat is reduced to 5 to 10% (Trout et al., 1992b). Huffman and Egbert (1990) observed that the overall acceptability of ground beef products peaked at a fat content of 20% level. Fat reduction can significantly affect the acceptability of the product (Giese, 1992) and increases the toughness of meat products (Barbut and Mittal, 1996). Young et al. (1991) observed that raw patties made from ground chicken thigh meat become lighter and more yellow in colour as fat content increased. The low-fat patties were harder, springier, less cohesive and chewier than high fat patties. However, Berry (1998) observed that fat content did not exert any major influence on colour of ground beef patties.

The manufacture of low fat products generally follows two basic approaches: the use of leaner raw materials and/or the reduction of fat and calorie contents by adding water and other ingredients that contribute few or no calories. These approaches can be supplemented by the use of a number of technological procedures that help to offset undesirable side effects produced as a result of changes to the product’s composition and nature. The aim is to reduce fat levels and/or modify fat characteristics and yet produce a product with acceptable levels of functionality, safety, sensory properties and stability (Yun et al., 2009). There are a number of procedures for the development of such products, which may be followed on their own or in combination, and are based on the following approaches.

2.1. Selection of Meat Ingredients to Secure A Raw Material That Is Suitable Both in Terms of Composition and Functionality

The composition of raw material can be adjusted by conditioning of the carcass composition using breeding and/or feeding strategies and by reducing fat levels in meat using a number of physical and/or chemical techniques. The level of carcass fat has been considerably reduced over the past 20 years. Meat producers and animal scientists have responded to this consumer demand by breeding animals with lower fat deposition and with leaner cuts of meat. Meat processors and researchers have also investigated, developed, and merchandised a range of low-fat meat products (Hsu and Chung 2000). Further, research has been also directed towards inducing changes in lipid components by modifying the feeding regimes of monogastric animals, so as to reduce the levels of saturated fatty acids and increase the levels of oleic acid present in the muscle and adipose tissue. The procedures to reduce fat levels in meat range from fat trimming to physicochemical techniques like dry concentration, centrifugation, and supercritical fluid extraction technology. Supercritical fluid
extraction is a process in which a gas exceeds its critical point under elevated pressure and temperature and, consequently, exhibits unique solvating properties leading to dissolving the fat contained in the meat. This process has been used to decrease fat and cholesterol content in ground beef and fresh meat (Clarke, 1991). Mechanical separation is a process during which connective tissue on the fresh meat trimmings is removed first in a parallel desinewing machine before a continuous heat exchanger is used to temper the meat trimmings. After the tempering, a proprietary separation process separates the lean from the fat (Anonymous, 1992). Cold rendering is another process in which a leaner product can be produced from fatter trimmings through cold-rendering with much of the original functionality remaining (Mandigo, 1992). Microwave cooking pads absorb fat lost in the cooking process, minimize its contact with food and, therefore, allow more fat to cook out (Costello et al., 1990).

2.2. Use of Non-meat Ingredients That Can Help Lend Desirable Textured Characteristics, Particularly Ingredients That Enhance Water Holding Capacity

The increase in consumer interest in reduced fat foods has created a growing need for low fat meat products in the market. Developing a lean or extra lean ground product, while assuring the necessary palatability demanded by consumers, is not as simple as just removing fat (Trout et al., 1992a). The active approach to fat replacement is to add fat replacers, which either replace fat or modify the interactions of the remaining components (Miller et al., 1993). Fat replacers in meats are ingredients that contribute a minimum of calories to formulated meats and do not dramatically alter organoleptic and processing properties. Fat replacers or substitutes are ingredients that contribute a minimum of calories to formulated meats and alter flavor, tenderness, mouth feel, viscosity and other sensory and processing properties (Cengiz and Gokoglu, 2007).

The direct replacement of fat with ingredients is an attractive alternative to fat reduction due to the functional and nutritional properties that the ingredients may impart. Many substitutes are used for partial replacement of the fat and may include added water (Sylvia et al., 1994), protein-based substitutes (Riisom, 1991), carbohydrate substitutes (Giese, 1992), vegetable and plant oils (Paneras and Bloukas, 1994), synthetic compounds (Keeton, 1994) and oat fibre/products (Yang et al., 2007). Fat replacers can be added to meat formulations to improve water and fat binding properties as well as to improve cooking yields, slicing characteristics and flavor (Schmidt, 1986 & 1988).

Among non-meat additives used as fat replacers are wheat flour in chicken nuggets (Rao et al., 1997), soy-flour in buffalo meat burgers (Modi et al., 2003), common bean flour in beef sausages (Dzudie et al., 2002), liquid egg and soy protein in goat beef patties (Gujral et al., 2002), amaranthus and buck wheat proteins in emulsion type products (Bejesano and Corke, 1998), whey protein concentrate in sausages (Laroia et al., 1995), gram flour in low fat duck meat patties (Reddy and Rao, 2007).
1997). In cooked meat products, a number of proteins (soy, maize, whey proteins, egg white, wheat and cotton), carbohydrates (starch, pectin, cellulose, gums, maltodextrins) and fat-based substitutes have been studied (Akoh, 1998). The results obtained were satisfactory, mainly with carbohydrates which improve cooking yield, enhance water holding capacity, reduce formulation cost and modify texture (Akoh, 1998; Jimenez, 1996). Rapaille (1991) observed that use of maltodextrins as partial fat replacer not only provide functional and sensory properties of fat but also produce low cost product. Berry and Wergin (1993) reported that incorporation of pregelatinised potato starch in low-fat beef patty formulations improved tenderness and cooking yield but reduced fat retention during cooking. Tapioca starch also was efficiently utilized as a fat substitute (Hughes et al., 1998). Miller et al. (1993) reported that low-fat ground beef patties with added water, with or without phosphates, were similar to 22% fat patties in sensory attributes, although added water increased thaw and cooking losses.

Gums are hydrocolloids, dissolve in water and produce gels which resemble fat in mouth feel, texture and sensory attributes. Guar gum, Xanthus gum and Locust bean gum are the common gums used in fat substitution (Pearson and Gillet, 1997). Ahmed et al. (1990) reported that added water could also be utilized as a fat substitute. Lin and Mei (2000) reported that incorporation of alginate, carrageenan, and soy isolate into reduced fat (about 15%) meat batter improved the emulsion stability and water holding capacity due to the protective effect of gums and soy protein on meat proteins. Lin and Keeton (1998) studied the textural and physico-chemical properties of low-fat, precooked ground beef patties containing carrageenan and sodium alginate. Results suggested that low-fat (5-10%) ground beef patties containing a combination of alginate and carrageenan were similar to regular beef patties (20% fat) regarding yields and textural properties. Desmond and Troy (1998) compared 17 commercially available non-meat adjuncts at 0.5 to 5.0% use levels and observed the highest flavor and overall quality scores for low fat beef burgers containing pectin, cellulose, oat fibre and carrageenan.

Protein-based fat substitutes have technological limitations (resistance to heat treatments, comparability with other constituents as flavor components which restrict their use (Lucca and Tepper, 1994). A variety of milk proteins including non-fat dried milk, sodium caseinate, milk co-precipitates and skimmed milk protein could be utilized as fat substitutes and texture modifying agents (Rao et al., 1998). Kumar and Sharma (2003) showed that incorporation of skimmed milk co-precipitate (as fat replacer) into low-fat (<10%) ground pork patties improved cooking yield, fat and moisture retention and reduced shrinkage and sensory properties were comparable with control (15%) patties.

2.3 Adoption of Appropriate Manufacturing and/or Preparation Technologies either to Induce Certain Functional Characteristics or to Vary the Composition of the Final Product
This includes use of technological treatments such as pre-blending, physical manipulation or high pressure during processing and/or preparation to modify properties that determine the stability and texture of meat products. Pre-emulsification of part of the fat with a non-meat protein (before addition to the meat batter) improves the system’s fat binding ability. This leaves more meat protein available to act in gel formation and enhance water holding ability (Bishop et al., 1993). Processing steps like grinding, freezing, cooking and packing are of particular interest in view of their influences on the yield, texture, colour and microbiological characteristics of low fat products (Jimenez, 2000).

3. Difficulties in Formulating Low Fat Meat Products

Translating idea into reality is not so simple a task. Negative sensory qualities have haunted low fat meat products. Research indicates that people prefer meat products with 15-20% fat. Low fat products, with fat contents starting below 15% tend to have less flavor intensity, juiciness and tenderness. It has been a challenge to formulate a low fat meat product in which the texture, flavor and appearance are not compromised. In addition to contributing valuable sensory qualities, fat functions to provide nutrients, namely the fat soluble vitamins (A, D, E & K). Another hindrance in the production of quality low fat meat products has been the expense. Reduced fat meats often cost more to produce than their whole fat counterparts. Finding inexpensive ingredients is the primary obstacle. Some fat replacers are relatively costly.

4. Conclusions

Although the demand is present for low fat meat products, formulating a low fat meat product equal in quality to its full fat counterpart is a difficult task. Choice of ingredients is critical to developing juicy, flavorful, low fat product that is inexpensive to produce. Water stretches the functionality of fat and increases yield. The key ingredient in a low fat meat formulation is the fat replacer or combination of fat replacers chosen. They can be either protein-based, fat-based, or carbohydrate based. Good fat replacers have a particle size and water binding capacity that mimics the mouth-feel and juiciness of real fat. They should be intrinsically bland, but have the ability to bind flavor chemicals and deliver flavor intensely to the consumer. Many formulations should be adequately tested by sensory panels. The final product should be equal to the full fat product in all aspects, except for fat. We require a better understanding of the interaction of substitutes with the ingredients used, processing procedures, storage conditions and final product preparation. When fat is being reduced in traditional meat products, one has to take into account the technological, microbiological, economic and sensory limits to this reduction if high quality products are going to be produced without any great reduction in their acceptability or shelf-life. Carbohydrate-based fat
replacers or mixtures of gums, starches, and/or proteins appear to offer the most effective means of replacing a significant portion of fat in meat products while duplicating the textural and sensory characteristics of animal fat. However, much work remains to determine the most appropriate combinations of ingredients and acceptable meat flavor systems for producing low fat meat products. In the end, the consumer declares the product a success or failure.

References


Copyright © 2013 by Modern Scientific Press Company, Florida, USA


