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Use of fruits and vegetables in meat and meat products in terms of dietary fiber

Meyve ve sebzelerin diyet lifi bakımından et ve et ürünlerinde kullanımı

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Abstract

Fruits and vegetables contain different amounts of dietary fiber. Fruit and vegetable wastes that are considered as food waste and have high added value are important in many aspects. Wastes with added value are used as dietary fiber. Dietary fiber added meat and meat products are effective for health and these additives improves meat in terms of technological properties. Dietary fibers have properties such as increasing water retention capacity, reducing formulation expenses, modifying texture, and improving storage stability in low-fat products. Dietary fibers have the opportunity to be used in meat products due to their technological features such as preventing cooking losses and improving texture as well as being functional. Consumers are increased in the awareness that there is a relationship between nutrition and health day after day. However, there are also concerns that diseases increase with improper diet. For this reason, it is recommended to increase the dietary fiber addition in the daily diet The use of dietary fiber as a filler in meat products can be a satisfying factor for conscious consumers. For this reason, production of meat and meat products rich in dietary fiber will guide new studies by using fruit and vegetable waste.

Keywords: Dietary fiber, Functional food, Fruits and vegetables, Meat and meat products

Özet

Meyve ve sebzeler farklı miktarlarda diyet lifi içerir. Gıda atığı sayılan ve katma değeri yüksek meyve ve sebze atıkları pek çok açıdan önemlidir. Katma değeri olan atıklar diyet lifi olarak kullanılmaktadır. Diyet lifi katkısı olan et ve et ürünleri sağlık için etkilidir ve eti teknolojik özellikleri açısından iyileştirir. Diyet lifleri, az yağlı ürünlerde su tutma kapasitesini artırma, formülasyon maliyetlerini azaltma, dokuyu değiştirme ve depolama kararlılığını geliştirme gibi özelliklere sahiptir. Diyet lifleri, fonksiyonel olmasının yanı sıra pişirme kayıplarını önleme ve dokuyu düzeltme gibi teknolojik özellikleri nedeniyle et ürünlerinde kullanılma imkânına sahiptir. Tüketiciler beslenme ile sağlık arasında her geçen gün bir ilişki olduğu bilincinde artmaktadır. Bununla birlikte, yanlış beslenme ile hastalıkların arttığına dair endişeler de vardır. Bu nedenle günlük diyette diyet lifi ilavesinin artırılması önerilmektedir. Et ürünlerinde dolgu maddesi olarak diyet lifinin kullanılması bilinçli tüketiciler için tatmin edici bir faktör olabilir. Bu nedenle diyet lifi yönünden zengin et ve et ürünlerinin üretimi, meyve ve sebze atığını kullanarak yeni çalışmalara yön verecektir.

Anahtar kelimeler: Diyet lifi, Fonksiyonel gıda, Meyve ve sebzeler, Et ve et ürünleri

1 Giriş

Dietary fiber is a group of food components that are indigestible in the small intestine [1, 2] fermented in the large intestine [3]. Lignin in the plant cell wall; lignin derivatives such as cutin, wax and suberin [2]; Structural polysaccharides such as cellulose, hemi-cellulose, pectin, oligosaccharides such as inulin and oligofructose [1, 2, 4, 5] are defined as dietary fiber. In addition, gum agents such as gum arabic and guar gum without structural compounds and seaweed polysaccharides such as carrageenan, agar, alginate [1, 4] are reported to be dietary fiber. Dietary fiber is also referred to as non-starch polysaccharide [5]. However, digestion-resistant starch falls outside this definition [3]. Because it is known that starch-derived products can be digested in the small intestine and resistant starch is partially hydrolyzed [6].

Meat and meat products are highly nutritious and versatile products that contain high biological value proteins, fat-soluble vitamins, minerals, trace elements and bioactive compounds. Meat contains high amounts of saturated fatty acids and cholesterol, which are often linked to health problems [7]. In addition, processed meat products contain high amounts of added salt [8] and fat [9], which are additional risk factors for various diseases. Epidemiological studies have shown an association between energy-rich diets and chronic diseases [10], and therefore increased consumption of dietary fiber has been proposed.

Consumers are increased in the awareness that there is a relationship between nutrition and health day after day. However, there are also concerns that diseases increase with improper diet. For this reason, it is recommended to increase the dietary fiber addition in the daily diet. In this review, the physiological role of dietary fibers in fruits and vegetables and their effect on the quality characteristics of meat and meat products will be examined.

The interest of researchers has shifted in this direction, since the use of dietary fiber in meat and meat products is effective for health and improves meat in terms of technological properties. Fruits and vegetables can be used in the products due to their high dietary fiber content. In addition, the pulp remaining as waste in the fruit and vegetable processing industry is not used much and is used as animal feed. To prevent this, wastes with added value are used as dietary fiber. Dietary fiber has many uses in food However, in this study, the use of fruit and vegetable dietary fibers in meat and meat products was examined.

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Table 1. Classification of dietary fiber based on solubility[1]

Class	Examples
Insoluble	Cellulose
Soluble (only in hot water)	Agars, amylose, aligns, kappa-type carrageenans (in the presence of K+ or Ca2+), gelan, konjac, mannan, locust bean gum, low methoxyl pectins, granular starches and starch derivatives
Soluble (in water at room temperature but insoluble in hot water)	Curdlan, hydroxylpropylcelluloses, hydroxylpropylmethylcelluloses and methylcelluloses
Soluble (in water at room temperature and hot water)	Alginates, amylopectins, carboxymethylcelluloses, dextrins, iota type carrageenans, guar gum, gum Arabic, high methoxyl pectins, polydextrose and xanthan gum

2 Dietary fiber

Dietary fibers are evaluated in two groups as soluble and insoluble fibers based on their solubility. Soluble dietary fiber connects the water to form a gel and firm structure. The insoluble dietary fiber absorbs up to 20 times its weight but does not form a viscous structure [1]. Dietary fiber improves fecal volume, shortens intestinal transit time and helps prevent constipation [6]. This effect is thought to be mainly caused by insoluble dietary fiber. Because the insoluble dietary fiber causes an increase in stool mass as a direct fiber. In contrast, soluble dietary fiber undergoes fermentation to form gas with short-chain fatty acids, and these compounds change the pH of the intestinal content, causing an increase in the mass of bacteria in the gut. However, it is reported that the soluble dietary fiber may cause an increase in stool volume, considering its water holding capacity and its role in gas formation [11]. On the other hand, soluble dietary fiber is known to be more effective in lowering cholesterol in the blood and reducing the absorption of glucose in the gut [8; 9; 10]. Foods that are generally rich in dietary fiber contain both fiber components in different proportions. It is reported that the amount of soluble fiber in fruits, vegetables, nuts [1] and oat bran [12] is higher in insoluble fiber content in wheat bran [12]. Examples of soluble dietary fiber are gum substances, pectin and other gel-like polysaccharides [4], β-glucan [6], inulin [15]; insoluble dietary fiber is given cellulose, hemicellulose and lignin in the plant cell wall [1].

3 Classification of dietary fibers

Dietary fiber is examined under two groups: water-soluble and water-insoluble. Table 1. illustrates the classification of dietary fiber based on solubility. Water insoluble fibers contains lignin, cellulose and water-insoluble pentoses, while water-soluble fibers; it contains water-soluble pentoses, pectins and gummy substances [12; 13]. Soluble and insoluble fibers are found in different ratios in foods containing dietary fiber. In pectin, apple, quince, etc. foods from the soluble fiber group; gums in resin; β-glucan, oats, etc. in foods; musilages in plants; resistant starch is found in dry legumes. Cellulose from insoluble dietary fiber group, in bran; hemicellulose is abundant in cereals and lignin in wheat [18]. Cellulose, lignin and hemicellulose, which are abundant in wheat and many cereal products, and vegetables, are dietary fiber components that are water-insoluble. Pectin and gum substances found in barley, oats, legumes and fruits are mainly water-soluble dietary fiber compounds.

Approximately 75% of dietary fiber in foods is insoluble [15, 16].

Since the digestive enzymes that break down dietary fibers into glucose units are not found in humans, these components cannot be digested completely and therefore cannot be absorbed. However, it gives some energy after fermentation in the intestine [16]. The fermentation rate varies depending on the metabolism, plant type, maturity, daily diet amount and composition. It is stated that dietary fibers affect bacterial species in human metabolism and control the intestinal flora and metabolism with their synergistic and antagonistic effects [21].

The quality of the part of the plant consumed, the level of maturation, storage conditions and food processing techniques are some of factors affecting the dietary fiber composition of vegetable foods. While the amount of cellulose, lignin and ash in the plant cell wall composition increases during the maturation of the plant; non-cellulosic polysaccharides, waxes and protein percentage tend to decrease [19].

There are many types of fruit used in fruit juice production such as apricot, sour cherry, peach, apple and orange. There are different recyclable components with high added value in the remaining parts after fruit processing. Dietary fiber concentrations from vegetables showed a higher total dietary fiber content and a better insoluble / soluble dietary content ratio than cereal bran [32].

4 Dietary fiber content of various fruits and vegetables

Fruits and vegetables contain different amounts of dietary fiber. In addition to the edible parts of fruits and vegetables, the inedible parts, namely those known as by-products, contain dietary fiber. By-products left over from food processing are an important source of dietary fiber. By-products obtained from processing fruits and vegetables into products such as fruit juice and fruit concentrates are a socio-economic source of dietary fiber. Table 2. gives information about water-soluble and insoluble dietary fibers of fruits and vegetables. It attracts attention as new and economical resources of a healthy functional component [22]. Such by-products can be defined as residues after the manufacture of fruit and vegetable based products; these remains include the shell, core, shell, stem, and core. Currently these by-products are disposed of animal feed, storage or incineration, usually at a cost to the producer; therefore, it creates potentially negative impacts on the environment [19, 20].

5 Reasons of use of dietary fiber in meat and meat products

Emulsified meat products such as sausages typically contain 20-30% fat and high amounts of water. Fat is an important source of energy and contains essential fatty acids as well as fat-soluble vitamins in meat [28, 29]. However, a possible relationship between saturated fat intake and various chronic diseases such as diabetes, cardiovascular diseases, obesity, infectious and respiratory diseases has increased the demand of consumers to consume healthy meat products [35]. As a result, the development of healthy meat products with added value for diet and low-calorie content has become one of the key targets for the food industry.

However, fat is also one of the main ingredients in foods and contributes to their texture and flavor and increases the feeling of fullness during meals [31, 32]. For these reasons, fat reduction in product formulas often means undesirable effects on technological and textural properties (eg increased cooking losses, impaired texture and low heating stability).

In the production of fat-reduced meat products, sensory and textural changes that occur as a result of fat reduction should be minimized [38]. One of the strategies applied to reduce the fat content in meat products is the use of fat with non-meat ingredients such as animal or vegetable protein, hydrocolloid or dietary fiber to achieve the desired textural properties and to achieve certain functional properties to affect the composition of the final product [33-35].

Various dietary fibers, alone or in combination, have been evaluated to replace fat in meat products as a result of different functional properties such as water retention, emulsion stability, tissue modification and neutral sweetener [29, 35-38]. Using dietary fiber as an oil replacement not only reduces the fat content, but also increases the nutritional properties of the product. It has been found that eating more dietary fiber reduces the risk of obesity, cardiovascular disease and colon cancer. The recommended dietary fiber intake for adults is 28-36 g / day, 70-80% of it should be insoluble fiber [44]. Another important reason for using dietary fiber is that their sources are generally relatively inexpensive agricultural by-products and their inclusion in meat products can reduce overall production costs [44].

6 Functions of dietary fiber in meat products

Dietary fibers have properties such as increasing water retention capacity, reducing formulation expenses, modifying texture, and improving storage stability in low-fat products [28, 29]. Due to the fact that dietary fibers reduce cooking losses and have a neutral taste, it finds use in meat products. For this purpose, sugar beet, peas [46], wheat, oats [30, 47], lemon albedoes [28, 32, 37], soy, apple, pear [38], peach, apple and orange [46] fibers are used in studies.

There is an increase is fiber addition in meat products for technological reasons and benefits to human health [50]. Fiber is suitable for meat products because it retains water, reduces cooking losses, has a neutral flavor and has been used in studies to develop meat emulsion products [50, 51]. By adding dietary fiber to meat products, it helps preserve the juicy structure of meat. In this way, the volatile components that affect the flavor of the product are preserved in the meat for a longer time [52]. Various dietary fibers have also been used as potential fat substitutes [53].

Dietary fibers have the opportunity to be used in meat products due to their technological features such as preventing cooking losses and correcting texture as well as being functional [38]. The technological effects of the fibers on the products change according to the source and amount of the fiber used. These effects of dietary fibers on texture are due to their water and oil binding properties [45]. Dietary fibers with high water holding capacity are used for the prevention of syneresis in foods, modification of viscosity and structure [54]. It is stated that the insoluble fiber holds 5 times the weight of the fat and prevents the loss of oil from the product during cooking. This is important in terms of preserving the taste of food and improving its technological features. It was determined that the fat absorption capacity of dietary fiber varies according to the particle size, and the fibers which have coarse particles absorb more fat. It is reported that dietary fiber source also affects the structure of the products. It is stated that apple and sugar beet fibers form a tighter structure compared to wheat fiber [55].

7 Use of dietary fiber in meat and meat products

Fibers obtained from oats, sugar beets, soy, apples and pears are used in some meat products such as sausage and beef patties [38]. Sayas et al [56] stated that, when 0.5%, 1%, 1.5% and 2% citrus-sourced fiber is added to fermented sausages, containing 2% fiber amount is not liked by the panelists because the products become granulated and acidic. It was determined that the textural properties of the fermented sausages containing 0.5% fiber was the closest to the control. Sensory analysis results revealed that fermented sausages added with citrus fiber negatively affected the flavor. Fernandez-Gines et al. [45], lemon albedoes, which were raw and cooked, were added to fermented sausages in 4 different concentrations. Thanks to the dietary fiber added to Bologna type sausages, the nutritional value of the product was increased and it was determined that the bioactive components reduce the amount of residual nitrite. It was found that the sensory properties of fermented sausages added with 2.5% and 5% raw and 2.5%, 5 and 7.5% cooked albedo were not different from fermented sausages produced by traditional methods. It was determined that the addition of cooked or raw albedo reduced the L* (brightness), the a* (redness), b* (yellowness), chroma (C*) and hue (H*) values [48]. There are studies in which there are significant changes in pH, lactic acid, TBARS, weight loss and penetrometer values of sausage samples were found with the addition of bitter orange albedo. It has been concluded that adding bitter orange albedo as a component to sausage formulation in Turkish style sausage yields positive results [57]. Peach fibers with high water holding capacity prevented the change of the textural properties of the product by keeping the water in the products with reduced oil [58]. According to the study of Akşit [58], some physicochemical and emulsion properties of quince, grape fruit and tomato pulp from food wastes were determined and potentials for use in sausage production were investigated.

Table 2. Soluble and insoluble fiber content of some fruits and vegetables (% dry matter)

Dietary Fiber Source	Soluble	Insoluble	References
By-products of fruits			
Orange peel	13.28	54.19	[2]
Lemon peel	31.81	41.86	[2]
Apple pulp	8	54.5	[3]
Peach peel	12	24	[3]
Grape pulp	9.53	68.36	[3]
Banana peel	12.84	70.16	[4]
Mango Shell	19	32.1	[5]
Pineapple Shell	5.9	36.3	[6]
Fruits			
Apple	5.8	7.5	[7]
Orange	9.8	5.2	[7]
Peach	7.1	6.4	[7]
Tomato	7.4	11.4	[7]
Palm	5.16-6.68	9.19-11.7	[8]
Vegatables			
Carrot	14.9	11.1	[7]
Potatoes	2.12	4.97	[9]

It was determined that all 3 pulp types have high hydration properties. According to dietary fiber analysis results, the total fiber contents of quince, grapefruit and tomato pulp were 87.90%, 90.34% and 63.76%, respectively. Sarıçoban et al. [59] stated that supplement of albedo raised stability of emulsions and emulsion capacity. The supplement of albedo as a dehydrated form proceeded better results in respect on the emulsion parameters. It has been reported that the addition of albedo provided an advantage especially in high-fat products to produce better emulsion. In the study by Grigelmo et al. [60], it was stated that dietary fibers obtained from orange juice are important in terms of water binding capacity and oil binding capacity. Sarıçoban et al. [59] stated that sunflower head pith had an effect on emulsification and viscosity properties of meat emulsions. It was reported that the addition of sunflower head pith at a concentration of more than 5% negatively affects the emulsion [61]. Tömek et al. [47] determined that the viscosity of sausage dough with 17% and 29% peach fiber and fat content varying between 5-20% increased with the amount of dietary fiber. In the same study, it was stated that dietary fiber increased the water holding capacity of the product and reduced cooking losses. It was determined that the color of sausages whose fat was reduced was darker than the control sample and only high fiber use negatively affected the texture of the product. In a study where the fat content of sausages was set at 5%, 10% and 20%, 2% citrus fiber or soy protein concentrates were added as oil substitute. It was determined that fat substitutes increased the energy values of sausages and decreased the cholesterol levels. However, there was no statistical difference between citrus fiber and soy protein concentrates. It was determined that the energy values and cholesterol levels of sausages could be reduced by 30-40% to 30-45%, respectively [62].

A previous study showed that beef patties containing various fibers had lower TBARS values than no-fiber patties [63]. Citrus fruits contain a higher proportion of soluble dietary fiber (33 %) compared to traditional grain fiber sources (7 %) [32, 64]. When lemon albedoes at 2.5, 5 and 7.5% levels were added to beef burgers, it was stated that the cooking characteristics of burgers had improved [48]. In the study of Güven [65], "The possibility of using carrot fiber in low-fat hamburger production" was investigated. It was found that as the rate of carrot fiber usage in hamburger patty increased, the moisture content of the samples increased. Since the amount of water in the samples with high fiber amount was high, there was an increase in the moisture content due to the increase in the total mass. Similarly, Aleson-Carbonella [49] stated that the increase in the moisture contents was found significant with the addition of lemon albedo at the rate of 0%, 2.5%, 5% 7.5% to hamburger patties prepared from beef. In a study of Sobrassada type fermented sausages, which are traditional for the Malorca region, a variety of carrot fiber was used (3%, 6%, 9%, 12%) [66]. The use of carrot fiber significantly affected the pH values of hamburger patty samples ($p < 0.05$). It was observed that the pH values of the samples tended to decrease with respect to the increase in carrot fiber ratio. It is thought that this decrease in pH may be due to the low pH (4.45) of the carrot fiber used [65]. In the study, it was stated that adding the dietary fiber suspension obtained from peaches in the ratio of 17-29% to low-fat frankfurter type sausages containing 5-20% of fat decreased the pH value [14]. Aleson-Carbonella [49] found that the addition of lemon albedo into beef hamburger patties significantly lowers the pH value. García [67], on the other hand, did not see a statistical difference between the groups in terms of color scores in the study where peach, apple and orange fiber were used at the rate of 15g / kg 30 g/ kg in Mortadela type sausages. The effects of adding 10% different concentrations of pea flour, pumpkin flour, and apple pulp in fiber-rich chicken wings, poor in salt and fat, were investigated. Addition of fiber sources significantly increased the total dietary fiber content of processed products [68].

Savadkoohi et al. [69] dried tomato pulp to use in meat products and ground and made ready for use in production by pH adjustment and scalding. In the results of the chemical analysis of the pulp (over wet weight), it was found that the amount of fiber was 39.11% and the amount of oil was 9.87%. In the study, where Oskaybaş [70] added pumpkin fiber to Sivas patties, it was observed that dietary fiber addition increased the moisture content. In the study of Avcı

[71], watermelon peel, melon peel and potato peel fibers were added to the Sivas patties and their textural and physical properties were examined. Although sensuous fiber dumplings are not preferred, they had positive results in terms of water binding capacity. Pea fiber produced from the inner cell wall of peas contains approximately 48% fiber. In studies, it was used to reduce the fat content of beef patties due to its high water holding capacity. As a result, it was provided cooking efficiency [72].

There are studies using fruit and vegetable wastes as coating material. In the study of Yüce [73], the use of carrot and orange pulp in the production of coated fish fillets was investigated. In the study of Aldemir [74], the possibilities of using tomato paste production wastes were investigated for coating fish fillets. Although microbial studies were conducted predominantly in these studies, dietary fiber and phenolic substances were examined in fillets as well.

8 Conclusion

In the food industry, by adding water, synthetic oil substitutes, protein or carbohydrate-containing additives, there are studies for the production of meat products with reduced fat ratio while preserving the textural and sensory properties of the product. However, it is stated that the best result is possible with the addition of dietary fiber.

It is emphasized that dietary fiber has advantages such as improving the textural properties of the product, reducing cooking losses, and reducing formulation prices. However, the most important feature of dietary fiber is that it has functional features that reduce the risks of discomfort such as colon cancer, cardiovascular diseases, constipation and cholesterol. Products with reduced fat content produced by the addition of natural ingredients such as dietary fiber are expected to increase the consumption of meat products, which has seen a significant decline in recent years, by meeting both the taste and health and safety expectations of the consumer. As a matter of fact, the use of dietary fiber as a filler in meat products can be a satisfying factor for conscious consumers. According to the researches, dietary fibers are added to various foods and their properties are examined.

Fruit and vegetable wastes that are considered as food waste and have high added value are important in many aspects. Dietary fiber comes first. For this reason, production of meat and meat products rich in dietary fiber will guide new studies by using fruit and vegetable waste.

Dietary fiber enriched meat products can be considered a good trend in terms of human nutrition and health. However, there are difficulties in effectively developing these functional meat products and reaching the consumers. The consumer's desire to consume meat products enriched in fiber should also be investigated broadly.

Çıkar çatışması

Yazarlar çıkar çatışması olmadığını beyan etmektedir.

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