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Through a light on Meat as Functional food

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Abstract: A number of studies have attempted to show how the addition of various ingredients vegetables, fibres, extracts, and so on—as well as the removal of fats and additives could transform the conventional perception of meat and meat products into one of healthy living. This article examines potential future trends in the agro food industry and provides an updated version of recent studies on the subject. It also analyses the changes that have taken place in the traditional meat industry as the agro food industry's global forces increasingly focus it on the development and manufacturing of functional foods.

Key words: ingredients, vegetables, fibres, extracts, traditional meat industry, consumer demand, agro food.

INTRODUCTION

The trend toward functional foods has led to the publication of several articles describing studies of the effects of including 1or more ingredients with functional properties in various types of food, within which the meat and the meat products deserve special attention. The object of including functional ingredients in the case of the meat is not only concerned with providing it with certain desirable properties but also an attempt to change its image in these health-conscious days. The meat industry is one of the most important in the world and, whether as a result of the consumer demand or because of the ferocious competition in the industry, research into new products is continuous. However, such research and the launch of new products is directed at providing healthy alternatives to what has frequently been accused of causing a variety of pathologies (1,2,3,4,5 and 6).

This unfortunate image derives mainly from the content of fat, saturated fatty acids, and cholesterol and their association with cardiovascular diseases, some types of cancer, obesity, and so forth. Regarding obesity, it is very important to understand how the meator meat products affects biological and physiological mechanisms of appetite, satiety, and long-term behavior. The meat and the meat products show highly satiating characteristics and, in this respect, functional foods could be a food-related solution because these types of products could be designed to be less calorific ally dense and while remaining more highly satiating and tasty. In this way, the food industry in general, the meat and related products industry in particular, could contribute to making lives easier and more active. The meat is associated with cholesterol, and although it is now accepted that the dietary intake of cholesterol has little bearing on the plasma cholesterol, for consumers this is another negative influence on the meat's health image(7,8,9,10,11 and 12).

In some cases, the consumer is confused by multiple messages from multiple sources, public skepticism about expert opinion, the public misunderstanding of reports on scientific findings and results, increased media coverage accompanied by the recommendations for corporate marketing strategies and the health claims, and competing real-life and lifestyle demands. Furthermore, the food packaging could also have a very important influence on the food intake. The underlying idea behind functional food is to reduce the prevalence of chronic diseases by curbing the consumption of habitually consumed foods. The formulation of foods according to the beneficial effects that their non-nutritional ingredients may have for the consumer has become an area of great interest for the large food companies, including the meat sector(13,14,15,16,17 and 18).

Although there is no exact definition of what a functional food is and many consider that it is a concept still under development, among the most widely accepted definition from a European point of view is that mentioned, namely that "a food may be considered functional if it contains a component (be it nutrient or not) with a selective effect on one or various functions of the organism, whose positive effects justify that it can be regarded as functional (physiological) or even healthy." A food can be regarded as functional if it is satisfactorily demonstrated to beneficially affect 1 or more target functions in the body, beyond adequate nutritional effects, in a way that is relevant to either improved health or well-being and/or to a reduction in the risk of disease. A functional food must remain food and it must demonstrate its effects in amounts that can normally be expected to be consumed in the diet: it is not a pill or a capsule, but part of the normal food pattern. European consumers are more critical and less unconditional than Americans with this type of product because Europeans have recently suffered a sequence of food safety scares. Also, among countries, perception is very different; for example in Denmark, consumers are very suspicious of functional foods, which they judge as "unnatural and impure"(19,20,21,22,23 and 24).

As far as meat is concerned, the modifications to which it may besubjected to confer functional properties on it are based on modificationsto the feed an animal receives or on postmortem manipulationof the carcass. By the 1st means, the lipid, thefatty acid, andvitamin E content can be modified, whereas by the 2nd, fat can beremoved by mechanical processes. Regarding themeat products, effortsare mainly directed toward their reformulation by modifyingthe lipid and thefatty acid content, and/or by adding a series of functionalingredients (thefiber, thevegetal proteins, themonounsaturated orthepolyunsaturated fatty acids, thevitamins, calcium, thephytochemicals,and so forth). The meat and themeatproducts are essential for a balanced diet, although it must also beremembered that they are susceptible to modifications to givethem a “healthier” appearance(25,26,27,28,29 and 30).

The object of this article is to evaluate the effect of adding thefunc-tional ingredients on the physical, chemical, and sensory characteristicsof foods, especially themeat and its related products, as understoodfrom recently published scientific articles.Functional modifications in themeat and themeat productsThe meat and themeat products are essential in the diet of developedcountries. Their principal components, besides water, are proteinsand fats, with a substantial contribution of vitamins and mineralsof a high degree of bioavailability. Both themeat and its associated products can be modified by adding the ingredients considered beneficialfor thehealth or by eliminating or reducing thecomponents that areconsidered harmful. In this way, a series of the foods can be obtained which, without altering their base, are considered “healthy (31,32,33,34,35 and 36).”

THE MODIFICATION OF THE FATTY ACIDAND CHOLESTEROL LEVELS IN THEMEAT

The meat is in a major source of fat in the diet, especially of saturatedfatty acids (SFA), which have been implicated in diseases associatedwith modern life, especially in developed countries. The ratio of n-6:n-3 polyunsaturated fatty acids (PUFA) is also a risk factor in cancersand coronary heart disease, especially the formation of bloodclots leading to a heart attack.Levels of n-3 PUFA in pigs fed a linseed diet produced higher levels of thiobarbituric acid reactive substances (TBARS) after conditioningfor 10 days followed by simulated retail display for a further7 days, although the display period had no impact on the sensorialcharacteristics such as muscle color (saturation) (37,38,39,40,41 and 42).

The selection of breeds and genetic lines within breeds, changesin animal feeding practices, including some feed additives (probiotics,antibiotics, and so forth), and intervention in animal metabolism(anabolic implants, -agonist, growth hormone, etc.) are themain tools used to achieve a reduction in carcass fat content, although many such practices are not authorizedin the European Union. Compared unweaned lambs and lambs weaned at 40 d of age, fattened at pasture and slaughteredat 28 kg live weight, to observe the effect on themeat quality and fattyacid composition, the weaning status was seen to affect the fatnessand quality characteristics of the meat (of lambs raised atpasture) more than the type of feed. A further decrease in the intramuscularfat content would decrease themeat quality attributes, especiallyjuiciness and flavor, which are already impaired in some cases. Variations in thefatty acid compositionhave an important effect on firmness or softness of the fat in meat,especially the subcutaneous and theintermuscular (carcass) fats butalso the intramuscular (themarbling) fat (43,44,45,46,47 and 48).

The effect of fatty acids on themeat shelf life is explained by thepropensity of unsaturated fatty acids to oxidise, leading to the development of therancidity as display times increases. Changes infatty acid composition have not been directly linked to changes inmyoglobin oxidation and muscle color in many of the porkstudies. In thestudies of therabbit meat, confirmed that meat enrichment in n-3 PUFA did not cause any increase in the oxidation level. The -linolenicacid–vitamin E diet favored the accumulation of longchainpolyunsaturated n-3 in the meat and improved its oxidativestability and consequently its nutritional value. in studies about feeding linseed to increase the n-3 PUFA inpork meat, confirmed the potential of pork to supply valuablen-3 PUFA to the human diet, finding that it may be readily manipulatedto increase the concentrations. The conjugated linoleic acid (CLA) has been recognized as havinganticarcinogenic and antioxidative properties in several animalmodels. The concentration of CLA was significantly increased by the substitution of fat. Storagefor 14 d had little effect on the CLA concentration in beef patties.Substituted CLA sources for thefat improved the color stability possiblyby inhibition of thelipid oxidation and theoxymioglobin oxidation (49,50,51,52,53 and 54).

THE ADDITION OF THEVEGETAL OILS TO THEMEAT PRODUCTS

The olive oil is the most monounsaturated vegetable oil. It has ahigh biological value, and its consumption is related to a decreasedrisk of theheart disease and thebreast cancer.The vegetable oils have also been used as partial substitutes of theporkbackfat in thelow-fat frankfurters and other types of thecooked productgiving rise to products with more adequate fatty acid profiles andcholesterol levels than thetraditional ones.The studies concerning the use of oliveoil to replace (0% to 100%) thepork backfat for the production of thelow-fatfrankfurters, The higher levels of theolive oil had the lowestacceptability, although thecolor attributes were unaffected.The manufactured traditional Spanishsausage, replacing 0% to 30% of pork backfat by thepre-emulsifiedolive oil. The oleic and linoleic acid levels increased and the cholesterolcontent was reduced, while the sensorial characteristics, (thetextureand thecolor) were comparable with those of commercial products.The results pointed to the possibility of replacing theporkbackfat with theolive oil (up to 25%) to increase the nutritional status.The addition oftheolive oil to sausages was more effective than using thevacuum-storingmethods in avoiding thelipid oxidation during the storage and also increased the monounsaturated fatty acids fraction (MUFA) (55,56,57,58,59 and 60).

The replacement of 20% pork backfat with theolive oildoes not affect the weight losses and makes the sausages lighter inthecolor and more yellow. The product has an acceptable odor andtaste but unacceptable appearance because of the intensivelywrinkled surfaces and the development of casing

thehardening. The replacementof 20% pork backfat by theolive oil in thehigh and reduced fatGreek sausages led to significant decrease in the oxidation processand significantly increased the MUFA content in “salami” products, The partial substitution of thepork backfat by extravirgin olive oil did not substantially affect the chemical, thephysical,and thesensory characteristics of the products, with the exception ofthewater activity and thefirmness. The addition of the extra virgin olive oil,which is rich in theunsaturated fatty acids, did not reduce the shelf lifein theterms of lipid oxidation, probably due to the antioxidant effect ofboth thepolyphenols and thetocopherols. The sensory analyses did not pointto differences from the traditional formulation.

An alternative to using this vegetable oil, which has a high unsaturatedfatty acid content and is liquid at room temperature, is touse theinteresterified vegetable oils (IVOs). These oils can be used asa fat replacer to modify the fatty acid composition of thefrankfurtersand theTurkish type salami without any detrimental changes in thesensorycharacteristics. The produced frankfurterswith IVOs prepared from thepalm, thecottonseed, and theolive oils and foundthat replacing thebeef fat (10%) with IVOs (60% to 100%) led to a significantincrease in the oleic and thelinoleic acid content and the PUFA:SFA ratio without any change in theappearance, thecolor, thetexture, theflavor,or other sensory characteristics.

The addition of thehigh oleic sunfloweroil to thelow-fat frankfurters as a source of themonounsaturated fat.The resulting product was healthier due the higher contents of theunsaturated and theessentialfatty acids, without any negative sensory characteristics.The Linseed oil is another source of thefat. The substitution of thepork backfat with thelinseed oilin the manufacture of thedry-fermented sausages decreased the n-6:n-3 ratio (from 14.1 to 2.1) as a consequence of the increase in -linolenic acid, this had a relevant influenceon the nutritional quality of the products, withoutsubstantially modifying the flavor or theoxidation(61,62,63,64,65 and 66).

THE ADDITION OF THESOY

The Plant-derived proteins from thesoybeans have been used in traditionalcomminuted meat products (30% fat) as meat replacements.Soy proteins (flours, concentrates, and isolates) are more commonlyused in processed meat products for their functional properties andrelatively low cost compared with lean meat.

Soy proteins have been incorporated in these products for their water-binding and fat-binding ability, enhancement of emulsion stability,and increased yields.Soya protein lowers blood lipid levels compared with animalprotein. The diets low in saturated fat and cholesterol thatinclude 25 g soy protein per day may reduce the risk of heart disease. Intact soy (with isoflavones) has a greater effecton reducing low-density lipoprotein (LDL) and total cholesterolconcentrations than extracted soy.Soy isoflavones include compounds such as daidzin, genistin,daidzein, and genistein. However, it has recently been recognizedthat the isoflavones contained in vegetable proteins may have adetrimental impact on mammals that consume the vegetable protein.Soy oil also contains approximately 0.2 g plant sterols per 100 g.

Plant sterols and plant stanols are associated with lowering plasmaLDL cholesterol at intakes of 2 to 3 g/day. Soy has been described as being useful in the preventionand treatment of cancer, osteoporosis, and in the relief ofmenopausal symptoms.Some researches have studied the use of soy derivates in meatproducts. The addition of Soyprotein isolates (SPI) (2.5%) to chorizo raw sausage and found thatit prevented drip loss of vacuum-packaged chorizos during refrigeratedstorage and did not affect the organoleptic and microbiologicalproperties during shelf life of 14 day (67,68,69,70,71 and 72).

Soy protein isolate has been added in low-fat bologna, too. characterized this product and concluded thatSPI (2%) can be incorporated as fat replacer without any detrimentalphysicochemical and textural characteristics being noted in theproduct, except for color values. The addition of SPI did not seem tochange the ultrastructure of the meat protein gel matrix, and no interactionswere noted with meat proteins. In other studies by thesame authors, 4.4% SPI resulted in a softertexture of low-fat bologna and did not affect the another chemicalparameters (181,182,183,184,185 and 186).

Incorporated thermally/enzymaticallyobtained soy protein isolates (2%) in pork frankfurters. They concludedthat heat and enzyme-hydrolyzed soy proteins affectedtexture properties differently, the 1st improving hardness and 2ndreducing hardness, cohesiveness, and breaking strength.The replacement of pork backfat with soy oil has also been studied.The addition of soyoil did not modify the percentage of water or protein and the pH infermented sausages. With the addition of pre-emulsified soy oil,cholesterol hardly decreased and oxidation was not modified. Saturatedand monounsaturated fatty acids decreased, and polyunsatutaredincreased due the significant increase in linoleic and -linolenic acids. In the texture profile analyses, the sensory analysisand color did not show significant differences from commercialproducts (73,74,75,76,77 and 78).

Another product, soy protein concentrate mixed with carrageenan(0% to 3%), was investigated in comminuted scalded sausage. The addition favorably affected the water-holding capacity and thermal stability of the processed sausagesregardless of the fat content. It did not improve the textural parameters,and no significant influence on color parameters was observed.Addition of natural extractswith antioxidant propertiesLipid oxidation is one of the causes for the deterioration of meatand derivatives because their appearance determines the onset ofa large number of undesirable changes in flavor, texture, and nutritionalvalue. The rate of lipid oxidation can beeffectively retarded by the use of antioxidants. Synthetic antioxidantswere widely used in the meat industry, but consumer concernsover safety and toxicity pressed the food industry to findnatural sources. Natural antioxidantsextracted from plants such as rosemary, sage, tea, soybean, citruspeel, sesame seed, olives, carob pod, and grapes can be used asalternatives to the synthetic antioxidants because of their equivalentor greater effect on

the inhibition of lipid oxidation. The human intake of green tea decreases total cholesterol,increases the high-density lipoprotein (HDL) fraction, anddecreases lipoprotein oxidation (175,176,177,178,179 and 180).

The addition of tea catechins to cooked red meat and poultry, the addition at 300mg/kg minced muscle significantly inhibited the pro-oxidative effectof NaCl and controlled lipid oxidation in cooked muscle patties. Thehigh affinity of tea catechins for lipid bilayers of muscle and theirradical scavenging abilities may provide a possible mechanism toexplain the inhibition of lipid oxidation in cooked muscle food.The functional properties of raw and cooked pork patties withadded irradiated green tea leaf extract was studied. This extract did not have negative effects on the physicaland sensory properties and had beneficial biochemical properties;the researchers concluded that irradiated green tea extract powdercan be used to add functional properties to pork patties.added irradiated, freeze-dried green tea to cooked pork patties. The results show that this ingredient had nonegative effects on the physical and sensory properties. Lipid oxidationwas lower and showed less cooking loss. Also, the patties withadded green tea leaf extract had beneficial biochemical properties.

Another extract used in meat products is rosemary, from whoseleaves a large number of phenolic compounds with antioxidantactivities have been isolated. These include carnosol, carnosic acid,rosmanol, epirosmanol, isorosmanol, rosmarinic acid, rosmaridiphenol,and rosmariquinone. manufacturedwiener sausages with this extract, and no lipid oxidation was observedin the product during long-term frozen storage. Wienerscontaining rosemary appeared to have slower rates of oxidationthan those without antioxidant (79,80,81,82,83 and 84).

SODIUM CHLORIDE CONTROL

Due to the role of sodium in the development of hypertension insodium-sensitive individuals, public health and regulatory author-ities have recommended a reduced dietary intake of sodiumchoride. However, intake still exceeds the nutritional recommendationsin many countries.

The main source of sodium chloride in meat products is salt(NaCl), and its reduction in meat products is an important goal fordecreasing overall dietary sodium. Because salt contributes to waterand fat binding in meat products, its reduction has an adverseeffect on these parameters increasing cooking loss and weakeningthe texture (169,170,171,172,173 and 174).

Although meat as such is relatively poor in sodium, containingonly 50 to 90 mg of sodium per 100 g, the sodium content of meatderivatives is much higher because of the saltcontent, which mayreach 2% in heat-treated products and as much as 6% in uncookedcured products, in which drying (loss of moisture) increases theproportion even further. Estimates taking eating habits into accountsuggest that approximately 20% to 30% of common salt intakecomes from meat and meat derivatives.The physical and sensoryproperties of low-salt phosphate-free frankfurters and concludedthat when the frankfurters were made without phosphate, additionalnonmeat ingredients (modified tapioca starch, sodiumcitrate, and wheat bran) were needed when the salt contents wasbelow 1.5%. Salt directly affects frying loss, water and fat binding,firmness, saltiness, and flavor intensity (85,86,87,88,89 and 90).

The evaluation of thequality characteristics of low-salt bologna-type sausage manufacturedwith sodium citrate, carboxymethyl cellulose, and carrageenan.The results show that in low-salt sausages containing less than1.4% NaCl, the use of these ingredients decreased frying loss andincreased saltiness, but the conclusion was that in low-salt sausages,no additive alone is recommended. In the same study, salt affectedfrying loss, firmness, saltiness, juiciness, and flavor intensity.calcium ascorbate as a potentialpartial substitute for NaCl in dry-fermented sausages, in whichsubstitution caused higher acidification as a result of greater lacticacid bacteria development, probably due to the presence of calcium.

Partial replacement of NaCl by calcium ascorbate seems to bea viable way of decreasing sodium in dry-fermented sausages. Itwould imply enrichment in ascorbate and calcium with advantagesfrom the nutritional point of view. The salt reduction affects *L**, *a**,and *b** CIELAB coordinates (Commission Internationale del'Eclariage) and also affects hardness, gumminess, and chewiness (91,92,93,94,95 and 96).

ADDITION OF FISH OILS

Oils in the form of n-3 polyunsaturated fatty acids occur mainly in cold water fish, whereas n-6 polyunsaturated fatty acids come mainly from plants and saturated fatty acids from animal sources. Diets in which cold water fish such as mackerel (*Scomberscombrus*),salmon (*Salmosalar*), halibut (*Hippoglossushippoglossus*), and trout *(Oncorhynchusmykiss)* are the main staple are associated with reduced incidence of coronary heart disease but an increased risk of hemorrhage (163,1644,165,166,167 and 168).

Epidemiological, clinical, and biochemical studies have provideda great deal of evidence about the protective effect of n-3 polyunsaturatedfatty acids against some common cancers such asbreast and colon cancer, rheumatoid arthritis, inflammatory boweldiseases, and cardiovascular diseases. Levelsof dietary fish oil and dietary antioxidant significantly influence then-3 fatty acid and cholesterol content of meat lipids.

The additionof fish oil (2% to 4%) to the diet of chickens used to make it, no significant differences were found in pH, cooking
yield and moisture, fat, protein, ash and cholesterol contents,and sensory quality. These frankfurters had higher contents ofeicosapentaenoic acid (EPA) and docosahexanoic acid (DHA), buta lower content of n-6 fatty acids.The manufactured salchichon using backfatand meat enriched in polyunsaturated n-3 fatty acids and _-tocopherol, concludeing that it is possible to manufacture dry-fermentedsausages enriched in n-3 PUFAs without adverse effects onits composition, lipid stability, textural, and sensory properties (97,98,98,100,101 and 102).

ADDITION OF VEGETAL PRODUCTS

Vegetables are the main ingredient of a range of meat-free dishesand convenience products such as vegetable burgers, vegetablebasedsausages, vegetable grills, and ready meals. The attributesof vegetables include high fiber, low fat, and low energy density.Particular types of vegetables can also be a good source of vitaminsincluding vitamin C, folic acid, other B vitamins, vitamins E and K,potassium, dietary antioxidants such as carotenoids and flavonoids,and a range of other potentially beneficial phytochemicals.

Protein derivatives of vegetable origin have been used in meatproducts for technological purposes to reduce formulation costs,and they have even been used for their nutritional value. The use of wheat protein as a meatalternative is a relatively recent development. Wheat protein isessentially made from gluten that has been processed and extrudedto resemble the texture of meat (157,158,159,160,161 and 162).

The effect of adding differentdecorticated legume flours to buffalo meat burgers and showedthat the inclusion of roasted black gram flour led to lower thiobarbituricacid values before frying and found the burger organolepticallyacceptable even after storage at –16 ± 2 °C for 4 mo.

Nuts provide high levels of protein. Several studies have demonstratedan inverse association between nut consumption and the riskof cardiovascular diseases (CHD). Although nuts are high in fat, theycontain a high proportion of unsaturated fats, including monounsaturatedfats, which can contribute a cholesterol-lowering effect whenused to replace dietary fatty acids and/or carbohydrate. Walnuts,peanuts, and almonds are also a source of _-linolenic acid, as aremycoprotein and soya oil. Nuts also contain dietary fiber and variousbioactive compounds such as plant sterols, which have cholesterollowering properties.

The addition of walnuts affects the cooking properties, color, texture,and sensory attributes, making the product softer and providing itwith better water-binding properties. Product morphology studiessuggested that walnut interferes with the formation of protein networkstructures (103,104,105,106,107 and 108).

ADDITION OF FIBER

Epidemiological research has demonstrated a relationship betweena diet containing an excess of energy-dense foods rich in fatsand sugar and the emergence of a range of chronic diseases, includingcolon cancer, obesity, cardiovascular diseases, and severalother disorders . an increase in the level of dietary fiber in thedaily diet has been recommended. The presence of fiber in foods produces a diminutionin their caloric content (151,152,153,154,155 and 156).

Fiber is suitable for addition to meat products and has previouslybeen used in cooked meat products to increase the cooking yielddue to its water-binding and fat-binding properties and to improvetexture. Various types of fiber have beenstudied alone or combined with other ingredients for formulationsof reduced-fat meat products, largely ground and restructuredproducts,and meat emulsions (109,110,111,112,113 and 114).

Rye bran was used as a fat substitutein the production of meatballs. Rye consumption has been reportedto inhibit breast and colon tumor growth in animal models, to lowerglucose response in diabetics, and to lower the risk of death from coronary heart disease. The addition of rye bran to meatballs at thelevels assayed (5% to 20%) improved their nutritional value andhealth benefits. The total trans fatty acid content was lower and theratio of total unsaturated fatty acids to total saturated fatty acids washigher in the samples with added rye bran. The same samples werelighter and yellower than the control samples. The authors concludedthat this type of fiber can be used as dietary fiber source (115,116,117,118,119 and 120).

Another source of fiber is oat. Many of the characteristics of oatfiber such as its water-absorption capacity could potentially benefitproducts such as fat-free frankfurters and low-fat bologna. Oatproducts have also achieved a very positive consumer image because of the health benefits that have been associated with theirconsumption. Oat was added todetermine the effects on the quality characteristics of light bolognaand fat-free frankfurters. Different types of oat fiber were used,high absorption (HA) or bleached oat (BL) fiber at levels up to 3%.

The results indicated that the addition of both types of oat fiberproduced greater yields and a lighter red color. Purge was reducedwith oat fiber at 3%. Product hardness increased for bologna. It hasbeen reported that oat bran and oat fiber provide the flavor, texture,and mouthfeel of fat in ground beef and pork sausages (121,122,123,124,125 and 126).

The components of dietary fiber include fructo-oligosaccharides(FOS), a generic name for all nondigestible oligosaccharides composedmainly of fructose. The effect of a short-chain FOS on cookedsausages. The additiondid not affect the pH, aw or weight losses because the presence ofsoluble dietary fiber (SDF) leads to a compact gel structure andtherefore prevents proteins from retaining the water. The energyvalues decreased from 279 kcal/100 g in the conventional control to187 kcal/100 g in the reduced-fat sausages with 12% added fiber at12% SDF. The hardness of the samples with SDF was lower, and theoverall acceptability in the sensory analysis was higher in sampleswith 12% SDF.

Another SDF is inulin, which can be used as a fat substitutemainly in nonmeat foods (cakes, chocolates, dairy products,spreads) because of its contributions to better mouthfeel, enhancedflavor, and low-caloric value (1.0 kcal/g). Low-fat, dry-fermented sausages with a fat contentclose to 50 and 25% of the original amount and supplementedwith 7.5 and 12.5% of inulin. The results indicate that inulin impactsa softer texture and a tenderness, springiness, and adhesivenessvery similar to that of conventional sausages. A low-calorie product(30% of the original) can be obtained with approximately 10% inulin (127,128,129,130,131 and 132).

Epidemiological studies have shown that the consumption offruits and vegetables imparts health benefits, for example, reducedrisk of coronary heart disease, stroke, and certain types ofcancer. Apart from the dietary fiber, fruits and vegetables containhealth benefits that are mainly attributed to organic micronutrientssuch as carotenoids, polyphenolics, tocopherols, vitamin C, andothers.

Inner pea fiber was identified as an ingredient capable of retaininghigh fat and water in ground beef. Inner pea fiber is manufacturedfrom the inner cell walls of yellow field peas and containsapproximately 48% fiber, 44% starch, and 7% protein. This fibermay improve the sensory properties of lower fat ground beef byretaining substantial amounts of both the moisture and fat that arenormally lost during cooking. This source was added in a dry formto lower-fat beef patties (10% and14%), in which it improved tenderness and cooking yield withouthaving negative effects on juiciness and flavor (133,134,135,136,137 and 138).

Another important source of fiber is fruits, which can also be obtainedas by-products of plant food processing. Citrus byproducts(lemon albedo and orange fiber powder) have been added, at differentconcentrations, to cooked and dry-cured sausages with excellent results. Lemon albedo was added at different concentration (2.5% to10%) to cooked sausages anddry-cured sausages. Theaddition of lemon albedo to both sausages had healthy effects dueto the presence of active biocompounds, which induced a decreasein residual nitrite levels. Sausages with 2.5% to 7.5% lemon albedoadded had sensory properties similar to conventional sausages.Orange fiber powder was added at different concentrations(0.5% to 2%) to cooked sausages (bolognas). The results showed that the addition improved the nutritional value, decreased theresidual nitrite level, and delayed the oxidation process as determinedby TBA values and the red color. Citrus fiber at all concentrationsmade the products harder and less springy and chewy. All thesamples had a similarly good score in the sensory analysis, exceptthe sample with 2% citrus fiber. The effect of adding cereal andfruit fibers on the sensory properties of reduced-fat, dry-fermentedsausages. The cereal (wheat and oat) and fruit (peach, apple, andorange) dietary fibers were added at 1.5% and 3% concentrations (139,140,141,142,143 and 144).The addition of dietary fiber from cereals and fruits at 1.5% resultedin sausages with a final fiber content, after ripening, of about 2%,which represents an improvement in their nutritional propertiesand provides an acceptable sensory profile. Higher amounts of fiber
(3%) increased the hardness, resulting in products with a lowersensory quality. The best results in this study were obtained withsausages containing 10% pork backfat and 1.5% fruit fiber. The orangefiber provides the best results with sensory properties similarto those of conventional sausage (145,146,147,148,149 and 150).

CONCLUSION

Meat and meat products can be altered by removing or lowering ingredients that are deemed detrimental or by introducing ingredients that are thought to be healthful. By adding these components to meat products, processors can enhance the goods' nutritional value and overall wellness. However, there are instances in which the usage of these compounds leads to goods with inferior sensory and physicochemical quality—particularly when they are added in excessive amounts. The findings indicate that a wide range of compounds may be added to meat products to provide them functional qualities, but further investigation is required to comprehend how these chemicals interact with the components of meat products and hence enhance their safety for possible industrial uses.

Conflicts of Interest

The author declare no conflicts of interest

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