

Utilization of Dietary Fibre in Meat Products as Functional Foods

Kuleswan Pame^{1*}, Bilifang Daimary² and Sanjib Borah¹

¹Lakhimpur College of Veterinary Science, AAU, Joyhing, North Lakhimpur, Assam, India

²College of Veterinary Science, AAU, Khanapara, Assam, India

*Corresponding author: kuleswan.pame@aau.ac.in (ORCID ID: 0000-0001-9735-147X)

Paper No. 970

Received: 11-12-2021

Revised: 09-02-2022

Accepted: 28-02-2022

ABSTRACT

Today nutritional disorders like gut related problems, cardiovascular diseases, type 2 diabetes, certain types of cancer and obesity are a major public health problem worldwide. These are believed to be caused by the rapid change in overall lifestyle due to impact of globalization. Meat consumption and demands for processed meat products is increasing rapidly with the increasing urbanization. Although meat means an important source of nutrients, it is also evident that a great consumption of this source of proteins has also a negative health impact due to its poor fibre content. It has been proclaimed that regular intake of dietary fibre prevents many of the above mentioned diseases. Various fibre rich sources have been attempted in different meat products attributed to their technological and health benefits. Therefore this review reflects the use of various dietary fibre sources in meat products with respect to their functional properties.

HIGHLIGHTS

- Utilization of fibres in meat products.
- Functional properties of various dietary fibres.
- Health benefits of dietary fibres.

Keywords: Dietary fibre, health benefits, functional properties

At present the influence of food on health and wellbeing of human is getting prime importance with the rapid expansion of knowledge among the people. The ever-increasing life style diseases have necessitated the development and demand for health beneficial food products or functional foods which can enhance their health and prevent these lifestyle diseases associated with food consumption. Consequently, this has led to the demand of meat products with low salt, fat, cholesterol, nitrites and calories by the consumers and they have started to embrace healthier meat products with health-promoting bioactive components such as carotenoids, unsaturated fatty acids, sterols, and dietary fibres. Despite the fact that meat is a highly nutritious food with its proteins having high biological value containing almost all the essential amino acids required by a human body, but meat

and meat products tends to be a poor source of dietary fibre. Regular consumption of meat product has been linked with various health disorder such as colon cancer, obesity and cardiovascular diseases (Larson & Wolk 2006). Food and Drug Administration (2013) recommended 20-30 g of dietary fibre intake on daily basis. However, due to various changes in the food habits, unbalanced diet, lack of moderation and variety in the food consumed, much of the population never received the recommended dietary fibre in the diet. Therefore, viewing the practical importance of dietary fibre with respect to human health, this paper reviews

How to cite this article: Pame, K., Daimary, B. and Borah, S. (2022). Utilization of Dietary Fibre in Meat Products as Functional Foods. *Int. J. Ag. Env. Biotech.*, 15(01): 147-151.

Source of Support: None; **Conflict of Interest:** None





on the uses of dietary fibre in the development of functional meat products. The term 'functional foods' was first introduced in Japan in the mid 1980s and refers to processed foods containing ingredients that aid specific bodily functions in addition to its nutritive value. The Institute of Medicines Food and Nutrition Board defined functional food as "any food or food ingredient that may provide a health benefit beyond the traditional nutrients it contains". A more comprehensive definition to functional foods was given by Roberfroid (2007). According to him 'a food can be regarded as functional if it is satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutritional effects, in a way that is relevant to either improved stage of health and well-being and/or reduction of risk of disease. Meat can be made functional by alteration in the formula of the meat products such as substitution and addition of different approved bioactive components. Currently one of the most commonly used techniques in preparation of functional meat product is utilization of dietary fiber.

Dietary fibre and their health benefits

Dietary fibres are the edible part of plants or analogous carbohydrates that are resistant to digestion and absorption in the small intestine with complete or partial fermentation in the large intestine of human. They are being claimed to promote beneficial physiological effects such as increasing the faecal volume, limits caloric intake, favours regulation of blood glucose levels, prevents cardiovascular diseases, colon cancer and constipation by regulating intestinal transit. Institute of Medicine, National Academy of Sciences (2001), defined 'Dietary fibre as non-digestible carbohydrates and lignin that are intrinsic and intact in plants. Added fibre consists of isolated, non-digestible carbohydrates that have beneficial physiological effects in humans. Health benefits of dietary fibre have been already established and well documented in various literatures over the past two decades. Deficiency of dietary fibre in the diet may lead to number of health issues like constipation, hiatus hernia, appendicitis, diabetes, obesity, coronary heart diseases, gallstones, etc. (Sudha *et al.* 2011). Consumption of adequate amount of dietary fibre reduces the risk of above-

mentioned diseases (Academy of Nutrition and Dietetics, 2015). Increased intake of dietary fibre is also associated with lower blood pressure and lower serum cholesterol levels (Brown *et al.* 1999). In addition adequate intake of fibre is suggested to aid in weight loss or prevent weight gain, mainly through satiety or fullness regulation (Faribanks *et al.* 2010; Mozaffarian *et al.* 2011; Wanders *et al.* 2011; Shay *et al.* 2012; Clark and Slavin 2013; Li *et al.* 2014) and appears to improve the immune function through promoting gut health and fibre-microbiota interactions (Watzl *et al.* 2005; Simpson and Campbell 2015; Dong *et al.* 2016). Increased intake of fibre in children has been found to be associated with lower risk of being overweight or obese (Choumenkovitch *et al.* 2013; Quick *et al.* 2013).

Dietary fibres: source and its use

Besides their positive effect on health, fibers are also being used in meat products for their functional properties such as; they reduce cooking loss due to their high-water binding ability, improve texture and imparts flavour and mouth feel due to their fat binding properties. Several dietary fibre sources like sorghum, wheat fibre, carrot, beet extract can be used for development of functional meat products. (Verma *et al.* 2009) used dietary fibre sources like pea hull flour, gram hull flour, apple pulp and bottle gourd in different combinations at 10 per cent level to develop functional chicken nuggets. Natural functional foods such as garlic, fenugreek, oats, flax seeds and spinach have been successfully incorporated in meat products to develop novel functional products. Allicin found in garlic gives the medicinal properties to this wonder herb. It strengthens up the natural defence and improves the immune system which helps in the prevention of cancer, heart disease, hypertension and decreases platelet aggregation. Fenugreek seeds being a rich source of various functional ingredients can be used for the development of functional meat products. Qureshi *et al.* (2018) successfully developed functional spent hen meat patties with improved quality. As such spent hen meat is relatively poor in functional ingredients. Fenugreek seeds being a rich source of various functional ingredients, and act as powerful anti-inflammatory and antioxidant properties which help in controlling cardiovascular



disease, blood glucose and cholesterol levels. Oats are rich in cholesterol lowering soluble fibre called beta-glucan. Intake of flax seed, especially its lignan fraction, and abundant portions of fruits and vegetables lowers the risk of cancer. Allium and cruciferous vegetables are especially beneficial, with broccoli sprouts being the densest source of sulforaphane. Protective elements in a cancer prevention diet include selenium, folic acid, vitamin B-12, vitamin D, chlorophyll, and antioxidants such as the carotenoids (Donaldson, 2004). Spinach is high in insoluble fiber, which may boost health in several ways. Spinach is composed of various active compounds, such as flavonoids and other polyphenolic active ingredients. These compounds are believed to act in combination with one another as; anti-inflammatory agents, antioxidative agents and anticancer agents (Nutrition and Cancer 2003). Lemon and oranges have been effectively used in dry fermented sausage for increasing soluble fibre content (Jauna *et al.* 2007). The main advantage of dietary fibre from citrus fruits when compared to alternative sources of fibre such as cereals is its higher proportion of soluble dietary fibre with about 33% in citrus fruits, while only 7% is present in wheat bran (Gorinstein *et al.* 2001). Oligosaccharides such as inulin, which is composed of a blend of fructose polymers extracted from chicory has been used in the preparation of various food products. Inulin has been used as a (low calorie) sweetener, to form gels, to increase viscosity, to improve organoleptic properties, and as a non-digestible fibre. Mostly it is used as a sugar and fat replacer in dairy products and as a prebiotic (Meyer, Bayarri, Tarrega, & Costell 2011). Examples of use in dairy are application in cheese, milk, yogurt and ice cream (Meyer *et al.* 2011). Some examples of use of inulin in non-dairy food are use in bread, biscuits, cereal and meat products (Gonzalez-Herrera *et al.* 2015, Karimi *et al.* 2015; Kuntz *et al.* 2013, Rodriguez Furlan *et al.* 2015). Intake of oligosaccharides improves beneficial intestinal microflora, reduces blood glucose levels, and reduces the production of carcinogens in the intestine (Anandh *et al.* 2003). Inulin has been used as a fat replacer in sausage, where it presented stimulating satiating properties (Archer *et al.* 2004). Turkey meat ball enriched with 10 per cent oats flour as functional component increased the cooking yield (Sivakumar *et al.* 2016). Pavan *et al.* (2016) effectively incorporated arrow

root (*Maranta arundinacea*) in chicken meat ball to provide novelty and health beneficial properties without affecting the sensory and microbiological quality. Jayanthi *et al.* (2016) developed functional chicken nuggets incorporated with 1.5% guava powder and recommended for those suffering with bowel disorder, hypertension and diabetes mellitus type-2. Finger millets are rich in calcium, iron, dietary fibre and antioxidant properties. Finger millet flour at 20 per cent level could be effectively incorporated in meat balls to provide novelty and health beneficial properties without the sensory and microbiological quality (Pavan *et al.* 2016).

CONCLUSION

The ever-increasing demands for more healthy meat products have paved the way for development of various functional meat products. In developed countries of the world, meat-based products are more preferred by the people; moreover the demand for processed meat products in different parts of the world has been increasing due to urbanization, improved standards of living and changing life styles. With the recent development in identification of bioactive compounds in plants and herbs, the meat products have been regarded as a potential route for delivering important nutrients in the diet of human beings in the form of functional products. However, literature survey shows not many studies have been conducted on the possible health benefits of functional meat products on human. Most of the conclusions are drawn based on the medicinal/beneficial effect of the active component derived from the functional ingredients. Therefore, further studies may be focused on providing strong evidences for human health benefits from functional meat products.

REFERENCES

- Academy of Nutrition and Dietetics. 2015. Position of the academy of nutrition and dietetics: health implications of dietary fiber. *J. of The Academy of Nutrition and Dietetics*, **115**: 1861–1870.
- Brown, L., Rosner, B., Willett, W.W., Sachs, F.M. 1999. Cholesterol lowering effects of dietary fiber: a meta-analysis. *Am. Soc. for Clinical Nutri.*, **69**: 30–42.
- Clark, M.J. and Slavin, J.L. 2013. The effect of fiber on satiety and food intake: a systematic review. *The J. of the Am. College of Nutri.*, **32**: 200–211.
- Choumenkovitch, S. F.McKeown, N.M., Tovar, A., Hyatt, R.R.,



- Kraak, V.I., Hastings, A.V., Herzog, J.B. and Economos, C.D. 2013. Whole grain consumption is inversely associated with BMI Z-score in rural school-aged children. *Public Health Nutr.*, **2**: 212-8.
- Donaldson, M.S. 2004. Nutrition and cancer: A review of the evidence for an anti-cancer diet. *Nutr. J.*, **3**.
- Dong, H., Laura J. Sargent., Chatzidiakou, Y., Saunders, C., Harkness, L., Bordenave, N., Rowland, L., Spencer, J.P.E. and Lovegrove, J.A. 2016. Orange pomace fibre increases a composite scoring of subjective ratings of hunger and fullness in healthy adults, *Appetite*, **107**: 478-485.
- Faribanks, L.A., Blau, K. and Jorgensen, M.J. 2010. High-Fiber diet promotes weight loss and affects maternal behavior in Vervet monkeys. *Journal of Primatology*, **72**: 234-242.
- FDA, 2013. Food and Drugs, Title 21. vol 2. CITE: 21CFR101.77.
- Gorinstein, S., Martin-Belloso, O., Park, Y.S., Haruenkit, R., Lojak, A., Ciz, M., Cuspi, A., Libman, I. and Trakhtenberg, S. 2001. Comparison of some biochemical characteristics of different citrus fruits. *Food Chem.*, **74**: 309-331.
- Gonzalez, S.M., Herrera, R.R., Lopez, M.G., Rutiga, O.M., Aguilar, C.N. and Esquivel J.C.C. 2015. **Inulin in food products: Prebiotic and functional ingredient.** *British Food J.*, **117**: 371-387.
- Institute of Medicine (IOM), National Academy of Sciences 2001. *Dietary reference intakes: proposed definition of dietary fiber.* National Academy Press, Washington, DC.
- Jayanthi, R., Appa Rao. V., Robinson, J.J.A., Valli, C. and Arunmozhi Varman, K. 2016. Nutritional properties of chicken nuggets incorporated with guava powder. *Proceedings of the 2nd convention of the association of meat scientists and technologists and national seminar on food: safety health and environment*, pp. 200-201.
- Jauana, F.L., Manual, V.M., Esther, S. and Sayas-Barbara, E. 2007. Orange fibre as potential functional ingredient for dry-cured-sausage. *European Food Research and Techno.*, **226**(1): 1-6.
- Karimi, R., Azizi, M.H., Ghasemlou, M. and Vaziri, M. 2015. Application of inulin in cheese as prebiotic, fat replacer and texturizer: *A Rev. Carbohydrate Polymers*, **119**: 85-100.
- Kuntz, M.G.F., Fiates, G. F. R. and Teixeira, E. 20015. Characteristics of prebiotic food products containing inulin. *British Food J.*, **115**: 235-251.
- Larsson, S.C. and Wolk, A. 2006. Meat consumption and risk of colorectal cancer: a meta-analysis of prospective studies. *Int. J. Cancer*, **119**(11): 2657-64.
- Li, S.S., Kendall, C.W., de Souza, R.J., Jayalath, V.H., Cozma, A.I., Ha, V., Mirrahimi, A., Chiavaroli, L., Augustin, L.S., Blanco, Mejia, S., Leiter, L.A., Beyene, J., Jenkins, D.J. and Sievenpiper, J.L. 2014. Dietary pulses, satiety and food intake: a systematic review and meta-analysis of acute feeding trials. *Obesity* (Silver Spring), **8**: 1773-80.
- Meyer, D., Bayarri, S., Tarrega, A. and Costell, A. 2011. Inulin as texture modifier in dairy products. *Food Hydrocolloids*, **25**: 1881-1890.
- Mozaffarian, D., Hao, T., Rimm, E.B., Willett, W.C. and Hu, F.B. 2011. Changes in diet and lifestyle and long-term weight gain in women and men. *N. Engl. J. Med.*, **23**;364(25): 2392-2404.
- Nutrition and Cancer. 2003; **46**(2): 222-231.
- Pavan, M., Kurian, Y., Nayar. R. and Rajagopal, K. 2016. Quality characteristics of functional chicken meat balls incorporated with arrow root (*Maranta arundinacea*). *Proceedings of the 2nd convention of the association of meat scientists and technologists and national seminar on food: safety health and environment*, pp. 189.
- Pavan, M., Kurian, Y., Nayar, R., Rajagopal, K., Sunanda, C. and Chethan, S.K. 2016. Quality characteristics of functional chicken meat balls incorporated with finger millet (*Eleusine coracana*). *Proceedings of the 2nd convention of the association of meat scientists and technologists and national seminar on food: safety health and environment*, pp. 199-200.
- Qureshi, A.I., Ahmad, S.R., Nazir, T., Pal, M.A., Sofi, A.H., Rovida, M. and Jalal, H. 2018. Efficacy of fenugreek seed powder for the development of functional spent hen meat patties *J. Entom. and Zool. Stud.*, **6**(5): 353-356.
- Quick, V., Wall, M., Larson, N., Haines, J. and Neumark-Sztainer, D. 2013. Personal, behavioral and socio-environmental predictors of overweight incidence in young adults: 10-yr longitudinal findings. *Int. J. Behavioral Nutr. and Physical Activity*, **10**: 37.
- Roberfroid, M.B. 2007. Inulin-type fructans: functional food ingredients. *J. Nutri.*, **137**: 2493-2502S.
- Rodriguez Furlan, L.T., Perez Padilla, A. and Campderros, M.E. 2015. Improvement of gluten-free bread properties by the incorporation of bovine plasma proteins and different saccharides into the matrix. *Food Chem.*, **170**: 257-264.
- Shay, C.M., van Horn, L., Stamler, J. 2012. Food and nutrient intakes and their associations with lower BMI in middle-aged US adults: the international study of macro-/Micronutrients and blood pressure (INTERMAP). *Am. J. Clin. Nutri.*, **96**: 483-491.
- Simpson, H.L. and Campbell, B.J. 2015. Review article: dietary fiber-microbiota interactions. *Alimentary Pharmacology & Therapeutics*, **42**: 158-179.
- Sivakumar, P., Amutha, R. and Karthiga, S. 2016. Effect of incorporation of oat fibre on physico-chemical properties of turkey meat balls. *Proceedings of the 2nd convention of the association of meat scientists and technologists and national seminar on food: safety health and environment*, pp. 188.
- Sudha, M.L., Rajeswari, G. and Venkateswara-Rao, O. 2011. Effect of wheat and oat brans on the dough rheological and quality characteristics of instant vermicelli. *J. Texture Stud.*, **43**: 195-202.
- Verma, A.K., Sharma, B.D. and Banerjee, R. 2009. Quality characteristics and storage stability of low fat functional chicken nuggets with salt substitute blend and high fibre ingredients. *Fleishwirtschaft Int.*, **24**(6): 52-57.
- Wanders, A.J., van den Borne, J.J., de Graaf, C., Hulshof,



T., Jonathan, M.C., Kristensen, M., Mars, M., Schols, H.A. and Feskens, E.J. 2011. Effects of dietary fibre on subjective appetite, energy intake and body weight: a systematic review of randomized controlled trials. *Obes. Rev.*, **9**: 724-39.

Watzl, B., Girrbach, S. and Roller, M. 2005. Inulin, oligofructose and immunomodulation. *British J. Nutri.*, **93**: S49-S55.