

# Bread towards Functional Food: An Overview

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**Abstract**—With a variety of foods that are currently available, it is our responsibility to choose the best food for the fastest impact on the development of mind and health. In general, the best food is the food that is lawful and clean, balanced, nutritious and schedule. These foods are called functional foods. Functional foods are classified as fortified, enriched or enhanced foods that provide health benefits with essential nutrients such as vitamins, minerals and antioxidants. Phytochemicals and phenolic antioxidants in plant including fruits, vegetables, herbs and spices are recognized as active ingredient which is responsible for human health. Opportunities for incorporating these active components into food like bread have grown rapidly since bread is one of the staple foods in many countries. Consumption of this functional food could enhance the human health performance and prevention from diseases. Therefore, bread containing antioxidant/phenolic content may lead to high consumer demand. This paper presents the potential of plant which have high antioxidant incorporated in bread to make it as a functional food. The review shows that the bread as functional food is a good source which has many benefits especially towards human health.

**Index Terms**—functional food, antioxidant, phenolic content, bread

## I. INTRODUCTION

Food has a very big influence on the body, mind and emotion. Nutrients derived from food are able to influence brain function and thus influence the behaviour and intelligence of a person's brain. In other words, our brain will develop and function properly with the availability of sources of protein, amino acids, fats, carbohydrates, fibre, vitamins and minerals derived from nutritional elements that are taken.

Functional food that has been processed or fresh gives high impact in build healthy body. It offers immunity and controlling body from the chronic diseases [1]. In addition, it also offers a range of additional nutrients which not found in ordinary food. Islam has put health as the noblest grace after grace of faith. It is already known that the stomach is the major source of illness. Therefore, many claims are found, either from the Qur'an or the hadith related to the properties of the food and also the rate of food uptake.

Bread is a staple food that closely related to people's daily life. It is prepared by baking dough which consists of flour, leavening agents and water. Bread is popular around the world and one of the oldest foods. Bread is

usually known as important source of carbohydrates in the food pyramid to ensure that a person can get enough nutrition that needed by the body. The way of thinking about healthy baking is to focus on their formulation ingredients. When formulating the ingredients, must keep in mind a number of requirements. These include final colour, texture and flavour, health benefits required, potential calorie reduction, fat and sugar replacement, fortification, interaction with other ingredients, processing requirements, proof times, baked good volume and bulk density, as well as baked times.

Interests in incorporating active ingredients such as dietary fibre and phenolic antioxidants into popular foods such as bread have grown rapidly, due to the increased consumer health awareness [2]. To make their fare healthier, bakers often reduce calories, sugar and fat, while upping fibre and water. But they also are seeking natural ingredients to replace chemically produced ones. Mold inhibitors are needed to help delay the growth of mold on bread products and help extend shelf life. Another way baker's address consumer preference for chemical-free formulations can involve replacing undesired ingredients with enzymes. And specialty proteins can be used to improve dough handling while eliminating the "unnatural" ingredients.

Several studies have been carried out to find potential sources of natural antioxidant in bread. The main characteristic of an antioxidant is its ability to trap free radicals. Highly reactive free radicals and oxygen species are present in biological systems from a wide variety of sources. These free radicals may oxidize nucleic acids, proteins, lipids or DNA and can initiate degenerative disease. Antioxidant compounds like phenolic acids, polyphenols and flavonoids scavenge free radicals such as peroxide, hydroperoxide or lipid peroxyl and thus inhibit the oxidative mechanisms that lead to degenerative diseases.

## II. POTENTIAL FUNCTIONAL INGREDIENTS FOR BREAD FORTIFICATION

### A. Soy Flour, Sweet Potato Flour and Flaxseed

Bioactive ingredients such as phytochemicals have a large impact in human diet and health. Phytochemicals are naturally found in plants and fruit including flaxseed and soybean. Soy flour offers a nutritious baked treat, diabetic friendly, gluten-free, dairy-free and cholesterol-free. Utilization of soy flour (5% and 10%) and flaxseed (15%) in yeast bread had been done by Conforti and Davis [3] to evaluate their effect on quality of the bread.

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Manuscript received January 1, 2015; revised April 10, 2015.

Though soybean and flaxseed have good nutritional value, incorporation with the bread does not achieve better results. This research revealed the bread had a lower volume, firmer texture and produced dark colour of the bread crumb and crust.

Purple sweet potato flour also can be used as a partial substitution of flour in making bread. It will increase antioxidant activity of the resulting bread. The best bread fortification was produced by a maximum substitution of 20% sweet potato flour [4]. Otherwise, it will decrease the bread quality characteristics such as bread specific volume, bread hardness and the pleasant purple colour of the bread.

#### B. Whole Grain – Buckwheat, Amaranth, Quinoa and Rye

Whole grains and fibre are the best ingredients to work into baking formulations. Recent technology has focused on health-directed ingredients without sacrificing fluffiness and flavour. Whole pseudocereal grains such as amaranth, buckwheat and quinoa contain high range of beneficial compounds which known to have good potential effect on human health. Compounds like flavanoids, phenolic acids and vitamins are available in these grains. Therefore, incorporation of these grains with bread dough formulations is highly recommended and the product should be the main part of the daily menu [5]. Research study on buckwheat flour, wheat flour, dry yeast, dough, and bread made from tartary buckwheat and wheat flour was analyzed by Vogrinčič *et al.* [6] in detection of total polyphenol, rutin, and quercetin concentrations and antioxidant activity. Total polyphenol content in dough and breads increased with the increase of percentage of tartary buckwheat flour used.

Besides that, rye (*Secale cereale* L.) also is a raw material for nutritional food. Rye flour often used to make bread. Rye bread is rich in biologically active compounds and has potential complexers of prooxidant metals and quenchers of the formation of singlet oxygen [7]. Rye breads are important sources of vitamin B and present better antioxidant properties than wheat bread [8]. Bread made from whole and brown rye flours is a main component of the diet in North and East European countries and is considered a good source of biologically active substances like antioxidants [9].

Study on pseudocereal grains on bread was also done by Alvarez-Jubete *et al.* [10]. The study determined the phenolic acid composition and antioxidant activities in bread making. All the bread containing pseudocereal grains significantly showed the highest antioxidant activities and total phenolic content. Therefore, enhancing the nutritional quality of baked product is essential to increase the quality of human health.

#### C. Green Tea Extract

Green tea extract contain polyphenols which are natural antioxidants. Nowadays, green tea is utilized as active ingredient in wide range of applications especially in food, nutraceutical and cosmeceutical industries. Wang *et al.* [11] have studied the effect of green tea extract as functional ingredient on bread quality. They discovered

that green tea extract was significantly contributed in the taste of the bread. Besides that, it also involved in hardness, sweetness, stickiness and astringency of the bread. Since the green tea contains excellent source of antioxidant, fortification with bread will provide functional food product with additional health benefits.

#### D. Herbs and Spices

Coriander leaf is one of the popular herbs and widely used in Western, Oriental and Arabic culinary. Coriander leaves contain vitamin A, vitamin B2, vitamin C and also rich in polyphenolic compound. It is also have potential on natural antioxidant source and its addition in food can enhance health benefit. Research was carried out by Das *et al.* [12] to evaluate the effects of the addition of coriander leaves powder on the antioxidant activity, shelf life and physical characteristics of the bread. The results showed fortification of coriander leaf powder in bread will enhanced the moisture content, slower staling rate, increased antioxidant activity as well as improved the texture, colour and flavour of the bread. Baking conditions such as time and temperature also have a significant effect on the physical properties of the bread. Herbal bread was baked for temperature 200 to 240 °C and time ranged from 10 to 30 minutes and the results were analyzed using response surface method. Result showed an increase in temperature and baking time has decreased the loaf weight but increased the loaf volume. Varying temperature and time combination when baking process could change the physical properties of coriander fortified wheat breads [13]. Bread enriched with powder coriander leaf into wheat flour will have beneficial in many aspects such as high antioxidant content, increase moisture retention capacity, efficiency baking characteristic and improved sensory characteristic in aspects of colour aroma and taste.

Turmeric or *Curcuma longa* L. is one of the most known spices that containing high natural antioxidant which benefit in human health. It is reported to have medicinal properties such as anti tumour, antimicrobial and anti inflammatory [14]. The incorporation of turmeric in bread markedly increases the antioxidant activities. This was proved by Lim *et al.* [15] who studied the physical characteristics, bioactive components and antioxidant activities with various levels of turmeric powder in bread dough formulation. The authors claimed that bread with 4% level of turmeric powder have higher antioxidant activity compared with normal bread. The study shows the potential of turmeric as functional ingredient fortified in bread. However, the physical appearance of bread must be taken into account as turmeric has strong yellow colour which will affect the consumer acceptance towards the bread.

The main problems of bakery product manufacturers are lipid oxidation and mould growth which limits the life period of their products. Study conducted by Lim and Mohamed [16] demonstrated that the highest antimicrobial properties were in turmeric and clove compared with other spices studied. Most inhibitory against moulds were lemon-grass and *Garcinia atroviridis*. Highest antioxidative activity showed in turmeric which

also results better than synthetic antioxidant. Turmeric has highest antimycotic and antioxidative for butter cakes compared with the other spices and synthetic antioxidants studied. This was followed by betel leaves, clove and lemon-grass. Consumption of turmeric, betel leaves, clove and lemongrass as natural antioxidant are better in preventing oxidative loss of life period in cakes processing rather than the usage of synthetic antioxidant.

Ginger (*Zingiber officinale Roscoe*) is herb that often used as a flavouring spice in cooking. Ginger is known possesses health benefits and it helps to keep body to stay active and fit. Ginger is also rich in antioxidants and has the ability to relieve stress or stress disorder. Antioxidant activities and total phenolic contents of Malaysia ginger has been studied by Ghamzadeh *et al.* [17]. High level of total phenolic content indicated high antioxidant activities. Enrichment of ginger powder at different levels in bread formulation affects the physical and chemical properties of the dough. High levels of ginger powder used modify the dough elasticity while moderate levels give no significant impact on bread rheological properties. Balestra *et al.* [18] reported bread containing ginger powder enhanced the antioxidant activities and 3% of ginger powder could include in the formulation without modifying the bread making performances. Bread rich with ginger powder increased the total phenolics content and the radical scavenging activity of bread extracts.

Ginger has gained considerable attention as a botanical dietary supplement in the United States of America and Europe in recent years, and especially for its use in the treatment of chronic inflammatory conditions [19]. In the scientific literature a large amount of information is available regarding the nutritional properties of ginger and its use to develop sweet bakery products [20]. Ginger has a strong capacity to make the bread very similar to the whole meal [21].

#### E. Fruits and Fruit Wastes

Ho *et al.* [22] reported that bread containing banana pseudo-stem flour had greater total phenolics and antioxidant activities than the normal bread. The study was conducted by comparing the control bread (normal bread), commercial bread, bread added with 10% of banana pseudo-stem flour and bread added with 10% of banana pseudo-stem flour, xanthan gum and sodium carboxymethylcellulose. The results showed that substitution of banana pseudo-stem flour reduced the physical quality of the end product. Nevertheless, addition of sodium carboxymethylcellulose can improve the loaf height, volume and density.

Banana fibre enrich of supplemental vital gluten could maintain the dough elasticity. Higher banana powder added will increase bread firmness due to the high sugar content. Samples with higher banana powder content will be darker due to the excess sugar in the banana powder. The proteins capacity extracted from dry mixes or dough decreased as the banana powder increased in the formulation [23].

Nowadays, phenolic antioxidants have been us as crucial food ingredients to promote extra health benefits

in many food products. Many researchers have been proved that total antioxidant activities were increase with thermal processing. Some question exhibit is whether the thermal processes would lead to significant alterations in the antioxidant capacities of phenolic added. Research study was carried out by Peng *et al.* [24] to investigate the antioxidant activity of bread fortified with grape seed extract. It showed that the antioxidant activity was higher with the increases of grape seed extract contents. However, thermal processing in bread-making might reduced the antioxidant content of grape seed extract in the bread sample.

Fennel (*Foeniculum vulgare var. dulce*) is an edible herb usually used to cure skin disorders, conjunctivitis and blepharitis. Extracts of fennel seeds contains essential fatty acids, proteins, minerals, fibres, higher antioxidant and antimicrobial activities. Bread mixed with fennel seed powder up to 7.0% exhibit high moisture content in the crumbs, greater antioxidant content and good consumer acceptability. The higher the fennel seed powder content in the bread produce better crumb firmness [25].

There are number of studies that have been done by the researchers to explore the potential sources of antioxidants in plant waste materials. Besides dietary sources, antioxidant also can be gained from food processing industries especially in agriculture by product [26]. The respective by products are seeds, rinds, bark, mill wastes and trimming wastes. The utilization of these by-products is beneficial to both the economy and the environment. The industrial by-products like peel and seed of the fruits are seen to have potential of antioxidant compounds sources.

Utilization of apple skin, one of the by-products of apple juices, apple pies and apple jams manufacturing could act as beneficial health food ingredients. There is a potential to incorporate apple skin in bakery products such as cakes, muffins and breads. Therefore, its contribution in antioxidant activity was presented by Rupasinghe *et al.* [27] and the authors indicated apple skin can be considered as natural antioxidant source for food products especially in bakery industries.

Watermelon rinds are potential sources of phenolic compounds and dietary fibre. Recently, there are number of studies have been undertaken to study the antioxidant properties in watermelon rinds [28], [29]. Fortification of its powder in bakery product is recommended to make economic use of local waste materials as well as to provide baked product with more nutritional values [30].

Mango peel is major by-products gained from mango production industries such as mango juices and jams. Due to that, mango peel is one of solid waste which contributes to environmental pollution. Ajila *et al.* [31] evaluated the ability of mango peel powder incorporated with biscuits dough and thus studied the antioxidant properties, physical and sensory characteristic of the dough. Final results presented wheat flour enriched with mango peel powder produced high dietary fibre content with improved antioxidant properties.

### F. Other Potential Ingredients

Olive oil adds vibrant flavours and textures to foods and is high in healthy, monounsaturated fats along with antioxidants. Baking with olive oil instead of butter reduces the amount of cholesterol and saturated fat in formulations. Olive oil produces lighter-tasting breads, brownies, biscuits and cakes. Wheat products contain beta carotene sources mixed with antioxidants normally show higher carotene stability when baking process. Beta carotene added in both bread and crackers indicated a greater stability when mixing, proofing (breads), baking and sheeting (crackers) of the dough [32].

The practice of using nutritional knowledge in food product to improve the health of consumer forms the general concept of functional foods. Caffeic acid had the greatest antioxidant activity, followed by ferulic acid, gallic acid and syringic acid. Result of antioxidant activity of dough and bread supplemented with phenolic acids when undergo baking process showed that caffeic acid was the highest effective in increasing antioxidant activity [33]. Nevertheless, Koh and Ng [34] reported that addition of ferulic acid to hard wheat flour reduces protein cross linking and releases sodium dodecyl sulfate-insoluble high-molecular-weight proteins. A recent study by Moore *et al.* [35] showed that the increase in soluble free ferulic acid content during whole wheat pizza dough fermentation was a result of enzymatic hydrolysis of insoluble bound or soluble conjugated ferulic acid by enzymes produced from yeast or other micro-organisms and by enzymes present in the dough.

Heat treatment changed the antioxidant activity of the bread. Increasing baking temperature and time might release the insoluble conjugated bound phenolic compounds and resulted in increasing antioxidant properties in whole-wheat pizza crust [35]. Furthermore, Sivam *et al.* [36] stated that phenolic extract had influenced bread dough cross-linking microstructure and bread properties through being involved in the interactions with bread components such as wheat proteins during dough development and bread baking.

Upon a certain level, the polyphenolic compounds may interact with the wheat starch or protein molecules during dough preparation/baking forming large complexes, degrading some of the phenolic compounds, thus reducing antioxidant activity [24]. It has previously been shown that changes in aroma, flavor and taste occur during storage of whole wheat bread [37]. Similar attributes have previously been shown to correlate with oxidation of food products in general [38]. In conclusion, phenolic acids can produce antioxidant effects after baking process and can give benefit to human health.

### III. CONCLUSION

Natural antioxidants such as flavanoids, tocopherols and phenolic acids may inhibit lipid peroxidation in food and improve food quality. Research published previously has covers many aspects relating to natural antioxidant. Many plant and food received much attention as sources of antioxidant but limited focus on its commercial applications. Interests in incorporating bioactive

ingredients such as dietary fiber and phenolic antioxidants into popular foods such as bread have grown rapidly, due to the increased consumer health awareness. When developing functional bakery products like bread, it is important to develop a product with physiological effectiveness and consumer's acceptance in terms of appearance, taste and texture. Therefore, future research work indicates the utilization of natural antioxidant in bread that can offer many benefits in the promotion of human health with necessary bread quality attributes such as hardness, surface colour, texture and flavour.

### ACKNOWLEDGMENT

The authors would like to appreciate for the financial and encouragement provided by Research Acculturation Grant Scheme (RAGS) [File No: 600-RMI/RAGS 5/3 (75/2012)], Ministry of Education (MOE) and Research Management Institute (RMI), Universiti Teknologi Mara, Malaysia.

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