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Kemenkes
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LAMPIRAN

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ORIGINAL ARTICLE

Plantain peel - a potential source of antioxidant dietary fibre for developing functional cookies

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Abstract Plantain cultivar *Nendran* is popular as a staple food in many parts of India and deep fried chips made from raw matured *Nendran* are one of the popular snack items in India. This study aims to utilize peel from *Nendran* variety- the main byproduct of banana chips industry- to develop high fibre cookies with enhanced bioactive content. Proximate analysis indicated that peels are rich in total dietary fibre (64.33 g/100 g), vitamins (Folic acid- 33.12 mg/100 g) and minerals (Potassium- 35.61 mg/100 g). *Nendran* Peel Flour (NPF) was extracted with hexane, ethyl acetate and methanol. Phenolic and flavonoid content was high for ethyl acetate extract (15.21 and 9.39 mg QE/g dry weight). Methanol extract was more potent in reducing Copper ion (2.36 μM TR/g dry weight) and scavenging NO (IC_{50}-381.71 μg/mL). Ethyl acetate extract was capable of scavenging DPPH and hydroxyl radical. HPLC profiling showed presence of gallic acid, protocatechuic acid, rutin hydrate and quercetin in ethyl acetate extract and gallic acid, chlorogenic acid and vanillic acid in methanol extract. Cookies prepared with NPF possess higher total dietary fibre content. There was a decrease in spread ratio, breaking strength and browning index of cookies as the percentage of NPF increased. NPF incorporation gradually increased the phenolic content from 4.36 to 5.28 mg GAE, compared to control cookie (3.21 mg GAE). DPPH scavenging activity also increased with increase in NPF. Hence NPF is a very good source of antioxidant dietary fibre and acceptable cookies can be produced by replacing wheat flour with 10 % NPF.

Keywords Nendran peel · Nutrition · Antioxidant activity · Cookies · Total phenolic content · DPPH scavenging

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Introduction

Fruits and vegetable processing waste is highly perishable and seasonal, and are a problem to the processing industries and pollution monitoring agencies. This problem can be recovered by utilizing its high value compounds, including the dietary fibre fraction that has a great potential in functional foods preparation. The increasing interest to find new sources of dietary fibres with specific bioactive constituents, may add new beneficial properties to the traditionally commercialized products. In this aspect the concept of antioxidant dietary fibre is gaining importance. Currently peels of a variety of fruits get focused as natural source of antioxidants and dietary fibre. With these grounds, banana peel has attracted attention as recent reports suggest it as a very good source of dietary fibre and antioxidants.

Banana/plantain (*Musa paradisiaca*) is one of the major fruit crops in India which is the largest producer of bananas in the world. These cultures occupy the fourth world rank of the most significant foodstuffs after rice, corn and milk (INIBAP 2002). Plantain is similar to unripe bananas in outward appearance, larger and their flesh is starchy rather than sweet, used mostly unripe, and require cooking. Peel-the main by-product of the banana processing industry represents approximately 30 % of the fruit. This by-product constitutes an environmental problem because it contains large quantities of nitrogen and phosphorus and its high water content makes it

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Food Science and Biotechnology

Utilization of Watermelon Rind Waste as a Potential Source of Dietary Fiber to Improve Health Promoting Properties and Reduce Glycemic Index for Cookie Making

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Abstract Watermelon rind powder (WRP) is a rich source of dietary fiber and bioactive compounds, hence it could be used in the development of functional foods such as cookies. Different replacement levels of wheat flour with either WRP or hi-maize starch (HMS) (10-30%) on the quality of the cookies made were studied. The dietary fiber content in the cookies increased with incorporation of increasing level of either WRP or HMS. Increasing the proportion of the WRP in the cookie making resulted in an increase in the total phenolic content, 2,2-diphenyl-1-picrylhydrazyl radical scavenging activity, and the ferric reducing antioxidant power. Using up to 20% of WRP and 30% of HMS in the cookie making promotes: increase in dietary fiber, decrease in predicted glycemic index to medium (for WRP) and low (for HMS) levels, and improving the antioxidant activity. These changes still produce an acceptable cookie.

Keywords: cookie, watermelon rind powder, glycemic index, hi-maize starch, non-enzymatic browning, antioxidant activity

Perpustakaan Poltekkes Bengkulu

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ORIGINAL ARTICLE

Effect of green tea powder on thermal, rheological & functional properties of wheat flour and physical, nutraceutical & sensory analysis of cookies

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Abstract Green tea powder (GTP) was incorporated in wheat flour at different levels (1, 2 and 4 %) and its effect on quality parameters of flour and cookies were studied. Thermal analysis showed that addition of GTP did not increase the onset temperature, end temperature and enthalpy of flour significantly. However, the increase in GTP content retarded the retro gradation of the gelatinized wheat flour gel and decreased the water absorption capacity, Oil absorption capacity, water solubility index, Foam capacity and foam stability significantly. The L* and b* values of cookies decreased from 53.63 to 33.23 and 29.02 to 24.39 respectively, while as, a* value showed an increase from 3.61 to 5.23 indirect proportion to quantity added. The addition of GTP to wheat flour increased the DPPH (2,2-diphenyl-1-picrylhydrazyl) percent inhibition and reducing power of cookies. Further, it also increases the acceptability for color, aroma and taste; however it loosened its structural integrity and decreased the fracture force.

Keywords Green Tea · Wheat Flour · Functional properties · Reducing Power · DPPH · Cookies

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Introduction

Cookies have been consumed for thousands of years and are still a tasty delight. Traditional cookies are made from common ingredients (wheat flour, water and salt), and although it is claimed to be rich in carbohydrate, it lacks other essential nutritional components, such as dietary fiber, vitamins and minerals, which are removed during wheat flour refinement (Choo and Aziz 2010). In the past few decades, the demand for wheat based products with added value has tremendously increased. Several workers have incorporated natural bioactive components into wheat flour to improve functional & nutraceutical properties of products prepared from it. For cookies and similar food types like pasta, bread and noodles, numerous natural additive sources, such as lupin and pigeon pea flours (Martínez-Villaluenga et al. 2010), common bean protein (Gallegos-Infante et al. 2010) milk protein concentrates and hydrolysates (Gani et al. 2014) and mango peel powder (Ajila et al. 2010) have been studied in order to improve the nutritional value and functional properties of the product.

Tea and tea products mainly contain tea polyphenols, which are natural antioxidants and have been demonstrated to show antioxidative, anti-carcinogenic and anti-microbial properties by many researchers (Rietveld and Wiseman 2003). These health benefits of teas, in particular that of green

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Functional, physical and sensory properties of cookies prepared from okara, red teff and wheat flours

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ABSTRACT

The present study was carried out to determine the effect of different proportions of red teff, wheat and okara on the physical, functional and sensory properties. The experiment was conducted in a D-optimal mixture design using Design Expert® and generated 16 runs with different proportions of three flours. The minimum and maximum values of red teff, wheat and okara were considered as 40-50%, 20-40% and 10-20% respectively. The functional, physical and sensory properties were determined for all the cookies as well as for the control sample (100% wheat) according to the standard methods. Statistically significant ($p \leq 0.05$) difference in bulk density was observed between red teff with okara. The water absorption capacity showed a highly significant difference ($p \leq 0.01$) in red teff with okara interaction. The highest hardness value (71 N) was recorded for cookies prepared from 40%, 10%, 50% of red teff, wheat and okara flour blends respectively, whereas the lowest value (23 N) was recorded for the control. The spread ratio of the cookies varied between 1.652 and 2.067. Okara concentrations affected the aroma and taste due to the beany flavour. The overall acceptability of cookies prepared from red teff, wheat and okara showed no significant difference ($p \leq 0.05$) in both linear and quadratic models and overall acceptability of the cookies from 100% wheat and blends was almost the same. In conclusion, the functional and physical properties of the cookies that are prepared with the different concentrations of okara, and teff blended cookies correspond to the levels shown by the control samples. In sensory analysis, overall acceptability of the cookies prepared with okara was similar to the control (only wheat). So, okara can be successfully used in the preparation of cookies.

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ORIGINAL ARTICLE

Functional and physicochemical characteristics of cookies prepared from *Amorphophallus paeoniifolius* flour

M. Suriya[1] · Reshu Rajput[1] · Chagam Koteswara Reddy[2] · Sundaramoorthy Haripriya[1] · Mudasir Bashir[1]

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Abstract This study was undertaken to prepare novelly formulated cookies from elephant foot yam flour (EFYF) with refined wheat flour (RWF) and evaluate their proximate composition, quality characteristics, texture, pasting and organoleptic properties. The formulated cookies prepared from EFYF, substituting RWF up to 70% had sensory properties similar to that of refined flour cookies (control). EFYF and RWF blend revealed reduced water and oil absorption capacity with increased peak and final viscosities when compared with RWF. Reduced lightness, increased redness and hardness were observed for formulated cookies with increase in storage time. Irrespective of the decreasing trend in their texture, overall acceptance of the EFYF cookies by the consumers was increased. Sensory scores revealed the preference of consumers towards formulated cookies. Overall analysis disclosed that the cookies prepared from *A. paeoniifolius* flour proved acceptable not only in quality characteristics but also fulfil the demand of functional foods in preparation of cookies.

Keywords *Amorphophallus paeoniifolius* · Cookies · Hardness · Refined wheat flour · Sensory analysis

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Introduction

Amorphophallus paeoniifoilus known as elephant foot yam is a tropical tuber crop, commonly available throughout India. It is widely used in the Indian traditional system of medicine and it contains adequate source of starch, nutrients, minerals and proteins (Hurkadale et al. 2012). In general, the corms of *A. paeoniifoilus* are a delicacy in food and it is commonly used as vegetable in delicious cuisines. *A. paeoniifoilus* tuber contains blood purifier properties and traditionally used for the treatment of abdominal disorders, asthma, dyspnoea, splenomegaly, tumors and rheumatism (Hurkadale et al. 2012; Singh et al. 2015). The tuber can acts as functional food due to the presence of starch and resistant starch which confers numerous physiological health benefits in humans predominately on individuals with degenerative diseases like obesity, diabetes and hyperlipidemia (Reddy et al. 2014).

Consumption of *A. paeoniifolius* is not widely practiced, and further storage of fresh yam is a difficult process and deterioration is rapid (Afoakwa and Sefa-Dedeh 2001). Studies have proved that drying techniques combined with blanching process have significantly improved its feasibility and viability option in food formulations (Suriya et al. 2016). Discoloration phenomenon is the common defect observed in fresh tubers which is mainly associated with enzymatic browning. The browning reactions happen due to action of polyphenol-oxidase and peroxidase enzymes (Asemota et al. 1992). Blanching process prevents browning reaction through enzyme deactivation. Therefore, preservation of *A. paeoniifolius* would be a vital step in unraveling the nutraceutical potential of *A. paeoniifolius*.

Moreover, the dietary guidelines advocate the consumption of composite flour against the refined flours because of the ill effects on humans (Devi and Haripriya

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ORIGINAL ARTICLE

Wheat-water chestnut flour blends: effect of baking on antioxidant properties of cookies

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Abstract Proximate composition, mineral content, functional, pasting and antioxidant properties of water chestnut flour (WCF) were compared with refined wheat flour. WCF showed higher phenolic (4.25 gGAE/1000 g), flavonoid (1.92 g QE/1000 g) and mineral content (K, Mg, Zn, Cu) than wheat flour. WCF showed greater retrogradation tendency but lower peak viscosity than wheat flour. Wheat flour - WCF blends and cookies were evaluated for water activity, physical & textural properties. Water activity of cookies decreased significantly (0.415–0.311) with increase in level of WCF in wheat flour. Total phenolic content, flavonoid content and antioxidant activity (DPPH• scavenging capacity, FRAP) of WCF - wheat flour blends as well as their cookies was also determined. Baking led to a greater increase in DPPH• scavenging capacity of WCF cookies (33.8%) than WF cookies (25%). Baking had a similar effect on FRAP value. Wheat flour cookies showed a decrease of 51%, and 62% while WCF cookies showed a decrease of 36%, and 34% in TPC and TFC values respectively. WCF cookies thus showed better retention of antioxidant activities suggesting greater stability of WC phenolics than wheat phenolics. Sensory analysis showed cookies made from water chestnut (100%) had fair acceptability due to their characteristic flavor. Thus, water chestnut flour serves both as a gluten free as well as antioxidant rich flour for production of cookies.

Keywords Water chestnut · Nutritional composition · Antioxidants · Cookie characteristics

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Introduction

One of the major challenges in baking industry is the production of gluten free products. Gluten, important for dough development, is usually associated with gluten intolerance and gluten sensitivity that have recently been categorized as two different medical conditions and are associated with the consumption of gluten protein. Usually those gluten free sources are preferred for incorporation in bakery products that are rich in starch. Keeping in view, various under-utilized food sources have been incorporated in bakery products. Incorporation of buckwheat, amaranths, quinoa, and barley has been thoroughly studied due to absence of gluten and rich antioxidant profiling. Among such gluten free sources is water chestnut that is not only rich in starch but has also been reported for its high flavonoid content. It also contains plentiful B vitamins (including B1, B2, B5 and B6), E, A and ascorbic acid. Water chestnut (*Trapa natans*) possess strong antioxidant, antimicrobial and anticancer activities, which have been attributed to their bioactive components, such as polyphenols, flavonoids and alkaloids (Yu et al. 2013; Chiang and Ciou 2010).

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ORIGINAL ARTICLE

Functional and physicochemical characteristics of cookies prepared from *Amorphophallus paeoniifolius* flour

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Abstract This study was undertaken to prepare novelly formulated cookies from elephant foot yam flour (EFYF) with refined wheat flour (RWF) and evaluate their proximate composition, quality characteristics, texture, pasting and organoleptic properties. The formulated cookies prepared from EFYF, substituting RWF up to 70% had sensory properties similar to that of refined flour cookies (control). EFYF and RWF blend revealed reduced water and oil absorption capacity with increased peak and final viscosities when compared with RWF. Reduced lightness, increased redness and hardness were observed for formulated cookies with increase in storage time. Irrespective of the decreasing trend in their texture, overall acceptance of the EFYF cookies by the consumers was increased. Sensory scores revealed the preference of consumers towards formulated cookies. Overall analysis disclosed that the cookies prepared from *A. paeoniifolius* flour proved acceptable not only in quality characteristics but also fulfil the demand of functional foods in preparation of cookies.

Keywords *Amorphophallus paeoniifolius* · Cookies · Hardness · Refined wheat flour · Sensory analysis

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Introduction

Amorphophallus paeoniifoilus known as elephant foot yam is a tropical tuber crop, commonly available throughout India. It is widely used in the Indian traditional system of medicine and it contains adequate source of starch, nutrients, minerals and proteins (Hurkadale et al. 2012). In general, the corms of *A. paeoniifoilus* are a delicacy in food and it is commonly used as vegetable in delicious cuisines. *A. paeoniifoilus* tuber contains blood purifier properties and traditionally used for the treatment of abdominal disorders, asthma, dyspnoea, splenomegaly, tumors and rheumatism (Hurkadale et al. 2012; Singh et al. 2015). The tuber can acts as functional food due to the presence of starch and resistant starch which confers numerous physiological health benefits in humans predominately on individuals with degenerative diseases like obesity, diabetes and hyperlipidemia (Reddy et al. 2014).

Consumption of *A. paeoniifolius* is not widely practiced, and further storage of fresh yam is a difficult process and deterioration is rapid (Afoakwa and Sefa-Dedeh 2001). Studies have proved that drying techniques combined with blanching process have significantly improved its feasibility and viability option in food formulations (Suriya et al. 2016). Discoloration phenomenon is the common defect observed in fresh tubers which is mainly associated with enzymatic browning. The browning reactions happen due to action of polyphenol-oxidase and peroxidase enzymes (Asemota et al. 1992). Blanching process prevents browning reaction through enzyme deactivation. Therefore, preservation of *A. paeoniifolius* would be a vital step in unraveling the nutraceutical potential of *A. paeoniifolius*.

Moreover, the dietary guidelines advocate the consumption of composite flour against the refined flours because of the ill effects on humans (Devi and Haripriya

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ORIGINAL ARTICLE

Functional and sensorial properties of cookies enriched with *SPIRULINA* and *DUNALIELLA* biomass

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Abstract The effects of *Spirulina platensis* and *Dunaliella salina* biomass (1% and 2%) on formulated cookies were studied. Colour, hardness, moisture content, ash content, protein content, lipid content, total phenolic content and total antioxidant activity by CUPRAC were assessed, and a sensory evaluation of the cookies was performed. The results show that the cookies baked with added *Spirulina* were significantly harder and darker than the controls, and the *Dunaliella* addition did not affect the protein content as much as the *Spirulina* addition, but the effect on moisture content was significantly positive. Additionally, higher total phenolic content and CUPRAC values were found for the *Dunaliella*-enriched cookies. After the sensory evaluation, the *Dunaliella*-enriched cookies were more acceptable to consumers.

Keywords *Spirulina platensis* · *Dunaliella salina* · Cookies · Chemical composition · Physical properties · Microalgae · Food

Introduction

Microalgae have been used for many years in human and animal nutrition and have received increasing attention due to their nutraceutical and therapeutic functions. They have attracted great attention due to their important therapeutic applications; offer a protective mechanism against diabetes and obesity, and are a promising source of protein and other biologically active ingredients (de Morais et al. 2015; Khan et al. 2018).

Spirulina biomass contains a highly digestible protein with a significant amount of gamma-linolenic acid and is a major source of each essential amino acids (Khan et al. 2018). It is also a source of structurally diverse exopolysaccharides, chlorophylls and phycobiliproteins that have multiple pharmaceutical functions, such as antioxidant, antitumor, antihyperlipidemic, neuroprotective, hepatoprotective, antibacterial and anticoagulant activities (Bishop and Zubeck 2012; García-Segovia et al. 2017).

The other most cultivated microalgae, *Dunaliella* sp., synthesises high amounts of carbohydrates, β-carotene, glycerol, Vitamin C and Vitamin A under stress conditions as salinity, irradiance and nutrient-limitations (Bishop and Zubeck 2012). Dunaliella biomass has great benefits in terms of the molecular improvement of recombinant proteins and decreasing the risk of cancer (Borowitzka and Siva 2007), making it useful for therapeutic, dietetic and industrial applications.

Due to these characteristics and its approval as 'generally recognised as safe' by the FDA, microalgae, especially *Arthrospira* (*Spirulina*) *platensis*, are widely used in the food industry as an ingredient in specialty food bars, powdered nutritional drinks, popcorn, beverages, fruit and vegetable juices, frozen desserts and condiments.

Increased consumer demand on healthy and functional foods has led to the development of low-fat, low-salt, gluten-free and sugar-free foods. In the presented work, *Spirulina platensis* and *Dunaliella salina* microalgae biomasses were used in homemade sugar-free cookie formulations in order to study the influence of the microalgae biomass on chemical characteristics, textural properties and sensorial properties.

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ORIGINAL ARTICLE

Use of coffee silverskin to improve the functional properties of cookies

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Abstract The purpose of this study was to determine the suitability of coffee silverskin (CSS) supplementation to enhance phenolic content and antioxidant capacity of cookies. Cookie samples were prepared with partial replacement of wheat flour by CSS (2.5, 5.0, and 7.5%). Spread ratios were found lower in all cookies with CSS than in control. Cookies became darker with increasing levels of CSS. This is due to the fact that CSS has a dark color like cocoa. CSS supplementation had improved functional quality of cookies by increasing phenolic contents, antioxidant capacities, and in vitro bioaccessibilities of them. According to the sensory evaluation, all samples with CSS received 6 and above scores (6: like slightly, 7: like moderately) for all attributes from the panelists. The results demonstrated that CSS supplementation have a good potential for developing functional and acceptable cookies and similar bakery products.

Keywords Cookie · Coffee silverskin · Antioxidant · Phenolic · In vitro bioaccessibility

Introduction

In recent years, the demand for functional food, which has positive effects on human health, has been increasing with the change in nutritional habits and increase in nutritional awareness. Especially the development of food products with high antioxidant activity and high dietary fiber is very important for healthy nutrition. In this context, a number of studies have been carried out to enrich the bakery products.

Coffee silverskin (CSS) is the thin tegument of the outer layer of green coffee beans and is a major by-product of the roasting process (Borrelli et al. 2004). During the roasting processes the residual CSS is completely removed (Esquivel and Jiménez 2012). CSS is an industrial waste that can easily be obtained in large quantities, and is likely to have a high added value. Nevertheless, it could not be recognized in the past and has been almost exclusively used as combustible or fertilizer (Saenger et al. 2001).

In recent years, consumption of coffee has increased; consequently, tons of coffee silverskin,which is the most important by-product derived from the roasting process of coffee beans, are produced every year (Kaplinsky 2004). This by-product is a very valuable economic resource rich in phenolic compounds, although once it seems like waste. It has a great potential in industrial applications as food additives or supplements of high nutritional value (Murthy and Naidu 2012a; Martínez-Pinilla et al. 2015).

The demand for coffee by-products such as coffee silverskin (bean testa, epidermis) is growing rapidly. Coffee silverskin is a natural source of a number of compounds that are likely to be beneficial to health (Borrelli et al. 2004: Napolitano et al. 2007; Murthy and Naidu 2012b; Martinez-Saez et al. 2014). Since it is not known that it has antioxidative and prebiotic effects as physiological functions, most CSS are discarded as industrial waste (Borrelli et al. 2004).

Antioxidant properties of coffee are associated to coffee silverskin fibre and this is attributed to the presence of chlorogenic acid (CGA) adhering to the dietary fiber matrix formed by a complex carbohydrate structure. For this reason, the dietary fiber in coffee silverskin is classified as antioxidant dietary fiber (Napolitano et al. 2007; Murthy

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ORIGINAL ARTICLE

Functional and antioxidant properties of cookies incorporated with foxtail millet and ginger powder

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Abstract The functional, sensory, nutritive, phytochemical and antioxidant properties of flours derived from wheat, foxtail millet and ginger along with the cookies formulated from these ingredients was studied. The foxtail millet (20, 30 and 40%) and ginger powder (5, 10 and 15%) blended wheat flours were investigated and compared to control (100% wheat flour). The increase in substitution levels of both the alternatives improved the functional properties of the composite flour and cookies formulated. Sensory analysis revealed that cookies prepared from 30% foxtail millet and 10% ginger powder had comparable scores. These were further subjected to nutritive and phytochemical analyses. The results revealed that cookies formulated using both the alternatives had reasonable proximate composition comparable to control. The substituted cookies had higher total soluble phenolic content and antioxidant capacities in terms of DPPH and ABTS scavenging potential and a strongly positive correlation was observed between the total soluble phenolic content and antioxidant capacities in composite flour and the cookies formulated from the flours. Overall the addition of foxtail millet flour (30%) and ginger powder (10%) improved the nutritional and phenolic linked antioxidant potential which can lead to shelf life extension and enhanced health benefits.

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Keywords Foxtail millet · Ginger powder · Cookies · Functional properties · Antioxidant capacities

Introduction

Cookies are very popular bakery products dried to a low moisture content having soft chewy texture (Okaka 2009). They are consumed extensively all over the world as a snack food and on a large scale in developing countries where protein and caloric malnutrition are prevalent (Chinma and Gernah 2007). With the increased advocacy on the consumption of functional foods by world nutrition bodies due to different health problems related to food consumption such as celiac diseases (life-long intolerance to wheat gluten, characterized by inflammation of the proximate small intestine), diabetes and coronary heart diseases, recent World Health Organization (WHO) recommendations suggest reduction in overall consumption of sugar and foods that promote high glucose responses (WHO/FAO 2003). Cookies are very popular bakery product among all age groups, especially with children and thus can serve as a vehicle for delivering important nutrients if made readily available to the population (Chinma and Gernah 2007).

Development of fortified composite flour bakery products such as biscuits and cookies are the recent trend in bakery industry. The enhanced nutritional properties of these products and other convenience factors such as easy packaging, longer shelf life and ready-to-eat formulation enable these products to be used in large scale feeding programs and relief campaigns during natural disasters. (Pratima and Yadava 2000).

Foxtail millet (*Setaria italica*) is mostly cultivated in southern region of India. Scarce availability of refined and processed millets in ready-to-use form has limited its wider