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Functional and Nutraceutical Bread prepared by using Aqueous Garlic Extract

H.A.R. Suleria1*, N. Khalid2, S. Sultan3, A. Raza3, A. Muhammad3 and M. Abbas4

1School of Medicine, The University of Queensland Australia
2Department of Global Agriculture, Graduate School of Agriculture and Life Sciences, University of Tokyo, Japan
3National Institute of Food Science and Technology, University of Agriculture Faisalabad, Pakistan
3Department of Food Science, Government College University Faisalabad, Pakistan

Abstract

Functional foods are gaining popularity worldwide in dietary modifications owing to consumer's preference, minimum side effect and low cost. Garlic (Allium sativum), is one of the most essential herbaceous vegetables having enormous health benefits. In this context, aqueous garlic extract was prepared followed by product development with resultant extract. In light of product development (Garlic bread) was prepared by adding aqueous garlic extract @ 3 mL, 6 mL and 9 mL. Phytochemical profile of aqueous garlic bread showed total phenols, flavonols, flavonoids, beta carotene, DPPH, FRAB, ABTS 1840.70±49.01, 8.87±0.22, 1840.70±49.01, 63.63±3.01, 50.41±0.79, 10.43±0.21 and 57.05±1.13 mg/mL, respectively. Furthermore, sensory evaluation of resultant bread was carried out by trained taste panelists. It was investigated that during external characteristics maximum scores for volume, crust color, symmetry and evenness of bakes were 7.90±0.21, 6.63±0.17, 3.36±0.6 and 2.33±0.1 respectively. In regard to internal parameters it was found that maximum scores for grain, crumb of color, aroma, taste and texture 12.85±0.5, 7.05±0.4, 8.05±0.5, 16.23±0.7 and 12.70±0.5 respectively. Moreover, all the scores for sensory evaluation remained in acceptable limit showing their suitability for its further utilization.

Key words: Functional foods, aqueous garlic bread, photochemistry of garlic, aqueous garlic extract and sensory attributes.

Introduction

Functional foods having wide range of phytochemical profile likes antioxidants, flavonoids have shown therapeutic potential against various health related disorders (Sameen et al., 2014; Perveen et al., 2013; Jenkins et al., 2008). The concept of diet-based therapies aimed at maximizing physiological benefits of various functional foods that require product development (Siró et al., 2008). Product development perspectives include selection of product, viewing segments of targeted population (Pernice et al., 2009; Paradiso et al., 2008).

Diet health linkage and concept of diet-based therapy have led to the introduction of functional foods (Suleria et al. 2015; and Suleria et al. 2013). High medical care cost is also one of the prominent factors to bring attention toward functional foods and its product development to reduce diseases risk. Health claims of various functional foods are affecting the consumer's acceptance, customer satisfaction, overall quality, convenience, price, age, and lifestyle (Verbeke, 2005). Plants are the cardinal components of human diet as they not only provide energy for metabolic pathways but also act as precursor for protein synthesis, source of micronutrients like vitamins and minerals. Garlic is bulbous perennial vegetable and used for various flavor and pharmaceutical industries (Suleria et al., 2014, 2012; Sadhna et al., 2011). Moreover, consumption of plant based foods like fruit and vegetables, cereals and nuts facilitate to improve health by reducing disease rate (Shahidi, 2009). All segments of the population like bread owing to their high nutritional value and easy digestive mechanism.

* †Corresponding author
Hafiz Ansar Rasul Suleria1* RHD Fellow, School of Medicine , The University of Queensland, Brisbane QLD 4072, Australia ,Phone: +61 7 321 44207; +61 470 439 670 (Mobile)

Bread, a fundamental dietary element dating back to the Neolithic era, is prepared by baking in an oven. It has several advantages at retails, materials and equipment reductions, greater varieties of bread; less production space is required and also facilitates the consumers and availability of fresh bread at any time of the day (Rosell, 2009). Bread flour contains 14.5% moisture, 13% protein, 0.55% ash with a pH of 5.7– 6.1 while the rest of the ingredients are in percent of that amount by weight (Zanoni et al., 1994). Shortening is added to improve the slicability or machinability. Fresh bread has a brownish and crunchy crust with pleasant aroma, tender and elastic crumb, fine slicing and a moist mouth feel (Giannou et al., 2003). Storage of different cereal products like bread, biscuits etc. at 4℃ for 12 and 24 h significantly increased resistant starch content. Amylose content in maize product showed a higher correlation with resistant starch than any other cereal products (Ruchi & Mini, 2011).

Currently due to mechanization, increased consumer demand, convenience and extended shelf life, and large scale production have developed the aim to use functional foods like emulsifiers and antistaling agents in bread to attain such desired quality (Stampfli & Nersten, 1995). In this context, various baking technologies were introduced in order to achieve improved response to market demands (Decock & Cappelle, 2005). Rheological properties for dough development are the cardinal properties for product quality and process efficacy. These properties are related to specific volume and textural characteristics of the bakery products (Phan-Thien & Safari-Ardi, 1998). The most commonly used equipment for empirical rheological measurements is farinograph (Razmi-Rad et al., 2007). The texture and density of bakery products mainly bread and cakes are under control of their rheological parameters and vapor content improvement throughout the baking process (Dobraszczyk & Morgenstern, 2003).

Fresh bread flavour is one of the essential characteristics for consumer acceptability and product recognition and these volatile flavours play cardinal role in the perception of fresh bread. The flavour perception involves entirely complex interactions between taste, sensory sensation of olfaction, and trigeminal stimuli (Lawless & Heymann, 1998). Various sensory descriptive analyses have been applied to estimate the flavour and odour impressions of foodstuff (Stone & Sidel, 2004).

Material and Methodology

Garlic white hybrid variety was procured from fruit and vegetable section of Ayub Agriculture Research Institute (AARI), Faisalabad, Pakistan. The raw material was cleaned to remove the adhered dirt, dust and other foreign materials. Afterwards, the garlic cloves were separated and peeled for further analysis and for the preparation of its aqueous extract.

Method to prepare garlic aqueous extract. The weighted peeled garlic bulbs were meshed to obtain a fine garlic juice. Afterwards, it was homogenized in 100 ml of 0.9% cold and sterile saline solution in a blender at high speed for 15 min. Filtration of homogenized mixture was carried out with muslin cloth. Resultant aqueous extract of garlic was stored at (−20oC). Garlic extract of different concentrations were prepared with 0.9% saline solution.

Product development (Garlic bread). Application of functional food in baking industry is one of the cardinal steps to cope the various physiological threats. It has been focused to introduce several bioactive chemical compounds in bread development. Utilization of the bioactive moieties in bread making process to not only improves dough handling properties, freshness, shelf life but main target is to combat various maladies. The raw materials were purchased from the local market. Prior to bread development, proximate of the bread flour was carried out using AACC, (2000). Different concentration of aqueous garlic extract was used to make breads treated with garlic extract.

Dough rheological studies. Farinograph and Mixograph. The rheological studies of wheat flours was assessed by Brabender Farinograph (Brabender GmbH & Co. KG, Germany) using the protocol of AACC, (2000). Furthermore, wheat flour sample was also subjected to mixograph (National Mfg. Co, Lincoln, Nebraska) using the standard method of AACC, (2000).

Garlic bread preparation. The breads were developed in the Bakery Section of the National Institute of Food Science and Technology, University of Agriculture, Faisalabad, Pakistan following the method AACC, (2000). Aqueous garlic extract was used in the recipe with different concentrations like @ 0, 3, 6, and 9 ml/250g flour. The garlic extract was used during the dough mixing process.

Phytochemical assay of aqueous garlic bread

The antioxidant extract obtained from garlic was analyzed for respective antioxidant potential following various tests including phytochemical screening and antioxidant activity. Total flavonols, tannin, flavonoids, total phenols, DPPH radical scavenging activity (1,1-diphenyl-2-picrylhydrazyl), antioxidant activity by beta carotene assay, ABTS (2,2'-azino-bis, 3-ethylbenzothiazoline-6-sulphonic acid) and FRAP (Ferric reducing antioxidant power) were assed by their respective protocols.

Total flavonol content. The total flavonol content was calculated by modifying the pervious method of Miliauskas et al. (2004). The quercetin calibration curve was prepared by mixing 1 mL of 0.150-0.05 mg mL-1 quercetin methanol solution with 1 mL of 2% aluminiumtrichloride and 3 mL of 5% sodium acetate. The absorption at 440 nm was measured after 150 min at 20 oC. The same procedure was carried out with 1 mL of plant extract (1 mg/mL-1) instead of quercetin solution. Total flavonol were expressed as mg quercetin equivalent per gram of extract.

Qualitative test for flavonoids. For qualitative analysis of flavonoids 2 mL of aqueous garlic bread extract was taken in test tube. 1 ml of conc. KOH was added to extracts and changed in color was observed from green to yellow. Then 0.5 ml of diluted ammonia was added in the extracts followed by the addition of 0.2 ml of conc. H2SO4 that gave yellow color indicating the presence of flavonoids.

Tannin content. Tannins were quantified by modifying the method of Bhat et al. (2007). 1 mL of garlic bread extract dissolved in 1 methanol and mixed with 5 mL of reagent mixture (vanillin and concentrated HCl dissolved in methanol). Change in color was observed at 500 nm UV-visible spectrophotometer (Shimadzu UV-160A) after 20 minutes. Catechin (20-400 µg mL-1) standard curve was made and tannin contents were expressed as mg catechin equivalent per gram of garlic bread extract.

Total polyphenol content (TPC). Total polyphenol content (TPC) in aqueous garlic bread extract was measured using Folin-Ciocalteu method (Singleton et al., 1999) based on the reduction of phosphotungstic acid to phosphotungstic blue. 50 µL of sample extract was mixed 250 µL of Folin-Ciocalteu's reagent followed by the addition of 750 µL 20% Na2CO3 solution. The total volume of the solution was mark up to 5 mL with distilled water. Absorbance was recorded after 2 hours at 765 nm with UV/visible light Spectrophotometer (CECIL, CE7200) against control, having all reaction reagents except sample aqueous extract. Total polyphenols were estimated and values were expressed as gallic acid equivalent (mg gallic acid/g).

DPPH Assay and Free radical scavenging activity. DPPH (1,1-diphenyl-2-picrylhydrazyl) free radical scavenging activity of sample extract was measured using the protocol of Brand-Williams et al. (1995). Different concentration of samples of garlic extracts was prepared using water as solvent. A fresh DPPH solution prepared in methanol of 200 µM was added in extracts. Then samples were placed in dark place for 30 minutes at room temperature and then measured the decrease in absorbance at 517 nm on UV/visible light spectrophotometer.

Antioxidant activity (AA). Antioxidant activity of sample was based on both oxidations of β-carotene as well as of linoleic acid. It was evaluated by method as described by Taga et al. (1984). For this purpose 2 mg of β-carotene was dissolved in 20 mL of chloroform. A 3 mL aliquot was dissolved with 40 mg linoleic acid and 400 mg Tween 20 followed by the addition of distilled water (100 mL) into the β-carotene emulsion, mix them well. 3 mL β-carotene emulsion and 0.12 mL phenolic extracts were mixed and immediately incubated at 50 °C. Oxidation of β-carotene emulsion was estimated after 30 minutes by measuring its absorbance at 470 nm on spectrophotometer.

Ferric reducing antioxidant power (FRAP). The ferric reducing power of sample extracts were quantifying by modifying the method of Yuan et al. (2000). Sample extracts were mixed well in phosphate buffer (0.2 M, pH 6.6) and potassium ferricyanide (1.25 mL, 1%) followed by incubation at 50 °C for 20 min. Samples were cooled and mixed with 10% TCA (1.25 mL). Afterwards, sample aliquot (1.25 mL) was mixed with distilled water (1.25 mL), 0.1% ferric chloride (0.25 mL), stay at room temperature for 10 min and absorbance was recorded at 700 nm.

ABTS (2,2'-azino-bis, 3-ethylbenzothiazoline-6-sulphonic acid) Assay:

For ABTS radical scavenging activity assay, the method of Roberta et al. (1999) was used. In this context, the ABTS radical was freshly prepared by adding 5 mL of a 4.9 mM potassium persulfate solution to 5 mL of a 14 mM ABTS solution and keeping the mixture in the dark room for 16 hours. This solution was diluted further with methanol and estimated an absorbance at 734 nm. The final reaction mixture, standard and extract were vortex for 10 sec and absorbance was recorded at 734 nm using a UV-visible spectrophotometer after 6 minute (Shimadzu UV-160A, Kyoto, Japan).

Sensory evaluation. The sensory evaluation of resultant garlic breads were carried out by following the procedure of Meilgaard et al. (2007). Slices of garlic breads were provided to trained panelist with random codes on different time intervals from 0, 24, 48, 72, 96 and 120 hours. The provided scores were plotted in standard bread score performa and statistically analyzed.

Result and Discussions

Extraction of aqueous garlic extract. Solvent extraction is one of the basic techniques for the isolation of active ingredients that may influenced by various factors like quantity of sample, time, solvent, ratio of solvent to material as well as temperature. All these factors are responsible for the extraction yield collectively. Furthermore, proximate composition of bread flour showed it contain moisture, ash, crude fiber, crude protein, crude fiber and nitrogen free extract 10.5±0.02, 0.51±0.01, 0.98±0.02,10.52±0.03, 0.38±0.01 and 87.61±2.34 respectively. It was reported by Salim-ur-rehman et al. (2006) that the moisture, crude protein, crude fat, crude fiber, ash and NFE contents of whole wheat and pearled wheat ranged from 8.34 to 9.21%, 9.02 to12.03 %, 1.70 to 3.50%, 1.20 to 3.90%, 1.61 to 2.21% and 80.05 to 84.81%, respectively. The highest concentrations of chemical constituents were present in whole grains except moisture and NFE.

Rheological Studies. The rheological properties of flour sample were determined using Brabender Farinograph. All the parameters like water absorption, arrival time, dough development time, dough stability time and mixing tolerance index were calculated from the graph. The means indicated that the water absorption (WA) was 57.9±0.8%, arrival time (AT) was 1.9±0.08 min, dough development time was 4.7±0.02 min. and dough stability (10±0.13 min).

Moreover, the flour sample exhibited the mixing time 5.5±1.2 min., peak height was calculated in 57.5±2.80% (Table 1).

Salim-ur-rehman et al. (2006) elucidated the effect of pearling on physico-chemical, rheological characteristics and phytate content of wheat-sorghum flour. It was found that water absorptions, dough development times, dough stabilities, tolerance indices, softening of dough and viscosities of wheat-sorghum flours ranged between 62-66.8%, 3.8-13 min., 20-70 BU, 65-100 BU and 400-515 BU, respectively. Results of farinographic study indicated by Salim-ur-rehman et al. (2006) were closed to our findings. Butt et al. (1997) reported that peak height of various wheat varieties ranged from 43 to 65%. Similarly, Rasool, (2004) elucidated that addition of non wheat plant materials like cottonseeds resulted in the decrease in peak height of composite flour. It was also found that replacement of non wheat flours with wheat flours result in reduction in gluten and dough dough stability. Singh et al. (2002) also showed the decrease in peak height value of wheat flour incorporated with lactic acid and fat.

Table 1. Means for farinographic and mixographic characteristics

Treatments	Values
WA (%)	57.9±0.8
AT (min)	1.9±0.08
DDT (min)	4.7±0.02
DST (min)	10±0.13
MTI (BU)	60±2.8
Mixing time (min)	5.5±0.09
Peak height (%)	57.5±2.80

WA= Water absorption
AT= Arrival time
DDT= Dough development time
DST= Dough stability time
MTI= Mixing tolerance index

Photochemical assay of aqueous garlic bread. It was evident from study that maximum flavonols were observed 9.06±0.02 at 45 minutes while minimum were 7.51±0.03 at 30 minutes in aqueous extract bread. Total flavonoids were dominant at 45 minutes followed by 30 minutes 91.13±0.83, 89.70±0.95 and 88.77±0.65, respectively. Means for tannins explicated that the highest tannin content 0.89±0.04a were at 45 minutes while lowest 0.80±0.04. Maximum value of TPC was recorded 1896.30±28.10 at 30 minute while lowest values 1804.00±15.52 after 1 hour. Aqueous garlic bread exhibited highest (DPPH) radical scavenging activity (51.13±0.55) at 45 minutes while lowest was 49.57±1.19b at 60 minutes. Similarly, it was observed that maximum beta carotene value was recorded 67.07±1.00, 62.43±0.60 and 61.40±0.66 at 45, 30 and 60 minutes respectively. The higher mean value of FRAP (10.65±0.04) was observed at 45 minutes followed by 60 minutes (10.42±0.06). Means for ABTS value regarding different time factor of 30, 45 and 60 (57.17±1.59, 58.13±1.18 and 55.87±1.60) mentioned in Table 2.

Table 2. Phytochemical assay of aqueous garlic bread

Treatments	Time			Means
	30 mint	45 mint	60 mint	
Flavonols	8.62 ±0.15c	9.06 ±0.02a	8.94 ±0.03b	8.87 ±0.22a
Total Flavonoids	89.70 ±0.95b	91.13 ±0.83a	88.77 ±0.65b	89.87 ±1.19a
Tannins	0.84 ±0.02ab	0.89 ±0.04a	0.80 ±0.04b	0.84 ±0.04a
TPC	1821.70 ±19.60b	1896.30 ±28.10a	1804.00 ±15.52b	1840.70 ±49.01a
DPPH	50.53 ±0.74ab	51.13 ±0.55a	49.57 ±1.19bc	50.41 ±0.79a
Beta Carotene	62.43 ±0.60bc	67.07 ±1.00a	61.40 ±0.66cd	63.63 ±3.01a
FRAP	10.22 ±0.04c	10.65 ±0.04a	10.42 ±0.06b	10.43 ±0.21a
ABTS	57.1 7±1.59ab	58.13 ±1.18a	55.87 ±1.60bc	57.05 ±1.13a

Means sharing same letters in a column/row do not differ significantly when n=5 at P < 0.05.

PC = Total Phenolic contents
DPPH= (1,1-diphenyl-2-picrylhydrazyl)
FRAP= Ferric reducing antioxidant power
ABTS= (2,2'-azino-bis, 3-ethylbenzothiazoline-6-sulphonic acid

Ademoyegun et al. (2010) has reported the total flavonoids present in varios cooked spices like garlic, onion and turmeric. It was investigated that prolong heating may force to resale the total flavonoid like at 1 hrs 105.56%, while increase for further hour it reaches to 114.13%. Hence, heat treatment can increase the resale level of free flavonoid (Stewart et al. 2000). Contrarily, one of the researches conducted on basil and ginger showed non-significant effect of total flavonoid content with function of heat treatment and time and depict that they are relatively stable under thermal heat. Cao et al. (1996) reported that vegetables especially belongs to allium species are quite rich in flavonoids contents. It was further investigated that garlic contained about 47 mg/kg quercetin, 639 mg/kg myricetin and 217 mg/kg apigenin. Furthermore, garlic also has greater antioxidant potential especially against peroxyl radical.

Yizhong et al. (2003) also reported the antioxidant potential and total phenolic content of methanolic extracts of garlic i.e. about equivalent of 55 µmol trolox/100 g of TEAC and total phenolic content is about 0.2 g of GAE/100g. Furthermore, Yara et al. (2009) also evaluated the antioxidant activity of different garlic preparations like fresh garlic, chopped with and without salt, fried and mixed garlic and concluded that fried garlic have greater antioxidant potential than other garlic preparations. It was found by Romson et al. (2010) that the total phenolic content of garlic, galangal, turmeric, dried chili and keang-hleung paste extracts determined by the Folin–Ciocalteu method were 0.3 ± 0.02, 0.2 ± 0.01, 0.3 ± 0.06, 0.6 ± 0.06 and 0.8 ± 0.02 mg GAE/100 g respectively. The DPPH (2,2-Diphenyl-1-Picrylhydrazyl) activity of garlic, galangal, turmeric, dried chili and the paste extracts were 0.38 ± 0.07, 0.65 ± 0.41, 1.01 ± 0.34, 0.28 ± 0.65 and 1.77 ± 0.38 mg GAE/100 g, while the ferric reducing power were 0.03 ± 0.01, 0.05 ± 0.01, 0.07 ± 0.02, 0.07 ± 0.02 and 0.05 ± 0.01 mg GAE/100 g, respectively. It was further studied that garlic is enrich in polyphenol and sulphur containing compounds that are actually responsible for better antioxidant potential.

Sensory Evaluation. A taste panel was assigned with the task of sensory evaluation of garlic breads in order to find the effects on external characteristics such as, volume, color, symmetry, evenness of bake along with character of crust. Similarly, the effects on internal characteristics were also investigated i.e. bread grain, aroma, taste and texture and crumb color.

External Characteristics. It was determined that external characteristics of bread were markedly affected by the addition of different concentrations of garlic extracts during storage. One of the attentions seeking sensory character of baked products is volume. Breads which were processed with different concentrations of garlic extract were assessed by volume at storage and was concluded that scores of T2, T3 and T0 are (7.8±0.5), 7.5±0.4 and (6.6±0.3d) respectively. Furthermore, due to the increase in storage time volume of bread was decreased so a negative correlation was observed. Just like volume, consumer's attraction towards the bread is also effected by the color shades of its outer crust. It is apparent from the means that the highest score (6.5±0 & 6.3±0.3) is showed by T1 & T2 respectively while the lowest score is shown as T3. In the same manner highest scores are obtained at 0 hours of storage followed by 6.9 ±0.2 at 24 hours and lowest scores (5.4 ±0.3) after 120 hours of storage. Measurement of symmetry depicted that the greater mean values (3.3±0.6 & 3.1±0.5) were determined in T2 and T3 respectively. While the minimum mean value (2.9±0.5) was determined in T0 during bread storage. Increased loosened structure was resulted from the addition of higher garlic extract because of the increased breakdown of cellulose, thus important changings were seen over various treatments. However, highest values (2.3±0.1 followed by 2.1±0.09) denoted by T2 & T3 respectively and the lowest value (2.0±0.1) denoted by T0, is shown in average values of evenness of baking. Lastly, during character of crust formation, T0, has minimum average value (2.2±0.2) and T1 (2.6±0.4) followed by T2 (2.6±0.3) have highest average values. Storage intervals and crust features got an indirect proportionality. At the beginning, result for storage intervals was highest (3.2±0.2) while after 120 hours it appeared to be lowest (1.8±0.2).

Internal characteristics. Flavor, texture, consistency, color of crumb and grain exhibited prominent effects after treatment. And these characteristics were equally exhibited in case of storage. Significant changes in bread grains have been observed that T3 (10.8±0.4) after T2 (12.8±0.5) showed maximum value and T0 (10.1±0.3) the lowest one. Aroma is also an important parameter for any product and makes the product preferable by consumer. It was observed during aroma study that highest value T3 (8.0±0.5) followed by T2 (7.8±0.5) and minimum value (5.9±0.6) denoted by T0. Storage intervals were in an indirect proportionate with aroma of bread. Fresh bread loaves had maximum value (8.6 ±0.2) of aroma and minimum value (4.96±0.3) after 120 hours. Storage time and treatment affects the taste of bread. T3 (15.3±0.5) has maximum value after T2 (16.2±0.7) and the value (12.5±0.5) of T0 is lowest. Taste was severely changed with the time and there was an inverse relation with taste and storage time. Lowest value after 120 hours and highest value at the initiation is 17.1±0.3 & 11.7±0.3 respectively. Texture of bread was significantly affected when its flour was incorporated with garlic extract. Highest average value (12.7±0.5) was denoted by T2 while lowest value was (10.6±0.3). At the beginning texture was best with the value of 13.4±0.2 while after 120 hour its value dropped to 10.0±0.2 and it had an inverse proportion with storage time. Finally, crumb color also affected by the addition of garlic extract and found that T3 (7.0±0.4) and then T2 (6.7±0.4) has highest value and T0 (6.2±0.3) has lowest value. Negative effects were shown by storage intervals over crumb color as shown in results. At the initiation highest score (7.6±0.2) followed by (7.3±0.1) at 24 hours was shown while after 120 hours lowest (5.7±0.3) value was shown.

Table 3. Changes in external quality characteristics of prepared bread with different treatments during storage at different time intervals.

Treatments	Hours							Means
	Characteristics	0 hr	24 hrs	48 hrs	72 hrs	96 hrs	120 hrs	
T_O	Volume	7.0±0.1gh	6.8±0.2hi	6.6±0.2ij	6.5±0.2ijk	6.3±0.2jkl	6.0±0.1l	6.6±0.3d
	Crust color	6.5±0.2cde	6.3±0.2def	6.2±0.2efg	6.5±0.2cde	5.9±0.2ghij	5.8±0.2hij	6.2±0.2b
	Symmetry	3.5±0.2bcd	3.3±0.3cde	3.2±0.2def	2.8±0.2fghi	2.4±0.3ijkl	2.0±0.1l	2.9±0.5c
	Evenness	2.1±0.2ab	2.2±0.4ab	2.0±0.1ab	1.9±0.2ab	1.9±0.3ab	1.8±0.2b	2.0±0.1b
	Crust	2.6±0.2bcdef	2.5±0.2cdef	2.2±0.2fghi	2.0±0.3ghi	1.9±0.3hi	1.8±0.2i	2.2±0.2b
T_1	Volume	7.3±0.2fg	7.2±0.2fg	7.0±0.2gh	6.8±0.2hi	6.5±0.2ijk	6.2±0.1kl	6.8±0.4c
	Crust color	7.0±0.1a	6.9±0.2ab	6.7±0.1abc	6.5±0.2cde	6.2±0.2efg	5.9±0.3ghij	6.5±0.4a
	Symmetry	3.5±0.7bcd	3.6±0.2bcd	3.2±0.2def	2.9±0.2efgh	2.5±0.2hijk	2.1±0.2kl	3.0±0.5bc
	Evenness	2.2±0.2ab	2.2±0.1ab	2.1±0.4ab	2.0±0.2ab	1.9±0.3ab	1.9±0.4ab	2.1±0.1ab
	Crust	3.2±0.2a	3.0±0.3ab	2.8±0.2abcd	2.4±0.4defg	2.2±0.4fghi	1.9±0.4hi	3.2±0.2a
T_2	Volume	8.4±0.2a	8.2±0.2ab	8.0±0.1bc	7.8±0.2cd	7.4±0.2ef	7.0±0.1gh	7.8±0.5a
	Crust color	6.6±0.1bcd	6.5±0.2cde	6.3±0.3def	6.2±0.1efg	6.6±0.2fgh	5.7±0.3ijk	6.3±0.3b
	Symmetry	4.1±0.2a	3.8±0.3ab	3.5±0.2bcd	3.2±0.2def	2.8±0.2fghi	2.4±0.2ijkl	4.1±0.2a
	Evenness	2.3±0.2a	2.3±0.3a	2.2±0.2ab	2.1±0.2ab	2.1±0.4ab	2.0±0.1ab	2.3±0.1a
	Crust	2.9±0.4abc	2.9±0.3abc	2.7±0.3bcde	2.5±0.1cdef	2.3±0.1efgh	2.0±0.1ghi	2.6±0.3a
T_3	Volume	8.0±0.1bc	7.7±0.1cde	7.5±0.3def	7.4±0.3ef	7.2±0.3fg	6.8±0.2hi	7.5±0.4b
	Crust color	6.3±0.3def	6.1±0.1fgh	6.0±0.1fghi	5.8±0.2hij	5.6±0.4jk	5.4±0.3k	5.9±0.3c
	Symmetry	3.7 ±0.1abc	3.5±0.2bcd	3.3±0.3cde	3.0±0.3efg	2.6±0.1ghij	2.3±0.2jkl	3.1±0.5b
	Evenness	2.2 ±0.1ab	2.2±0.3ab	2.1±0.3ab	2.0±0.1ab	2.0±0.2ab	2.0±0.3ab	2.1±0.09ab
	Crust	2.8 ±0.3abcd	2.7±0.3bcde	2.5±0.1cdef	2.2±0.1fghi	2.0±0.2ghi	1.8±0.2i	2.4±0.3b
Mean	Volume	7.7±0.6a	7.5±0.6b	7.3±0.6c	7.1±0.5c	6.9±0.5d	6.5±0.4e	
	Crust color	6.6±0.2a	6.5±0.3ab	6.3±0.2bc	6.3±0.3c	6.0±0.2d	5.7±0.2e	
	Symmetry	3.7±0.2a	3.6±0.2a	3.3±0.1b	3.0±0.1c	2.6±0.1d	2.2±0.1e	
	Evenness	2.2±0.08a	2.2±0.08a	2.1±0.08ab	2.0±0.08ab	2.0±0.09ab	1.9±0.09b	
	Crust	2.9±0.2a	2.8±0.2ab	2.6±0.2b	2.3±0.2c	2.1±0.1cd	1.9±0.09d	

Table 4. Changes in internal quality characteristics of prepared bread with different treatments during storage at different time intervals

Treatments	Hours							Means
	Characteristics	**0 hr**	**24 hrs**	**48 hrs**	**72 hrs**	**96 hrs**	**120 hrs**	
T_O	**Grain**	10.5±0.1hijk	10.4±0.1hijkl	10.2±0.2jklm	10.0±0.1klmn	9.8±0.2mn	9.6±0.2n	10.1±0.3c
	Crumb color	6.6±0.2efghi	6.5±0.1fghij	6.3±0.1hijkl	6.1±0.2jklm	5.9±0.3lm	5.7±0.3m	6.2±0.3c
	Aroma	6.7±0.3ijkl	6.5±0.1klm	6.2±0.1mno	5.8±0.2o	5.2±0.2p	4.9±0.3p	5.9±0.6d
	Taste	13.5±0.1lmn	12.8±0.4op	12.5±0.1pq	12.2±0.2qr	11.9±0.3rs	11.7±0.3s	12.5±0.5d
	Texture	11.1±0.2ijk	10.9±0.3jkl	10.7±0.3klm	10.5±0.3lmn	10.1±0.2no	10.0±0.2o	10.6±0.3d
T_1	**Grain**	11.3±0.3ef	11.1±0.4efg	10.8±0.2fghi	10.5±0.3hijk	10.2±0.2jklm	9.9±0.4lmn	10.7±0.5b
	Crumb color	7.0±0.1bcde	6.8±0.3cdefg	6.7±0.1defgh	6.5±0.2fghij	6.2±0.2ijkl	6.0±0.2klm	6.6±0.3b
	Aroma	7.5±0.1efg	7.3±0.2fgh	7.0±0.2hij	6.6±0.2jklm	6.3±0.3lmn	6.0±0.2no	6.8±0.5c
	Taste	14.6±0.2ij	14.2±0.1jk	13.9±0.3kl	13.7±0.3lm	13.4±0.4mn	13.1±0.2no	13.8±0.5c
	Texture	11.5±0.3hi	11.2±0.1ij	10.9±0.2jkl	10.7±0.3klm	10.4±0.4mno	10.1±0.2no	10.8±0.5c
T_2	**Grain**	13.5±0.3a	13.2±0.4ab	12.9±0.4bc	12.6±0.4cd	12.4±0.3cd	12.1±0.2d	12.8±0.5a
	Crumb color	7.2±0.2abc	7.0±0.3bcde	6.8±0.4cdefg	6.6±0.1efghi	6.3±0.3hijkl	6.1±0.3jklm	6.7±0.4b
	Aroma	8.4±0.3ab	8.3±0.2abc	8.0±0.2bcd	7.7±0.3def	7.3±0.3fgh	6.9±0.2hijk	7.8±0.5b
	Taste	17.1±0.3a	16.8±0.2a	16.3±0.3b	16.0±0.2bcd	15.6±0.4def	15.2±0.2fgh	16.2±0.7a
	Texture	13.4±0.2a	13.1±0.3ab	12.8±0.3bc	12.5±0.3cd	12.2±0.2def	11.8±0.2fgh	12.7±0.5a
T_3	**Grain**	11.4 ±0.3e	11.2±0.4efg	10.9±0.4efgh	10.7±0.1ghij	10.4±0.2hijkl	10.3±0.2ijklm	10.8±0.4b
	Crumb color	7.6 ±0.2a	7.3±0.1ab	7.1±0.2bcd	6.9±0.2bcdef	6.6±0.2efghi	6.4±0.2ghijk	7.0±0.4a
	Aroma	8.6 ±0.2a	8.4±0.2ab	8.3±0.2abc	7.9±0.2cde	7.6±0.4def	7.1±0.2ghi	8.0±0.5a
	Taste	16.1 ±0.3bc	15.7±0.3cde	15.3±0.2efg	15.1±0.2gh	14.8±0.3hi	14.5±0.3ij	15.3±0.5b
	Texture	12.3 ±0.3de	12.0±0.2efg	11.7±0.3gh	11.4±0.2hi	11.1±0.3ijk	10.9±0.2jkl	11.6±0.5b
Mean	**Grain**	11.7±1.2a	11.5±1.2a	11.2±1.1b	11.0±1.1bc	10.7±1.1cd	10.5±1.1d	
	Crumb color	7.1±0.4a	6.9±0.3ab	6.7±0.3bc	6.5±0.3c	6.3±0.2d	6.1±0.2d	
	Aroma	7.8±0.8a	7.6±0.8a	7.4±0.9b	7.0±0.9c	6.6±1.0d	6.2±1.0e	
	Taste	15.3±1.5a	14.9±1.7b	14.5±1.6c	14.3±1.6d	13.9±1.6e	13.6±1.5f	
	Texture	12.1±1.0a	11.8±0.9b	11.5±0.9c	11.3±0.9d	11.0±0.9e	10.7±0.8f	

It is accounted by Federica et al. (2011) in their research that if the ginger powder is added in the bread formula, it will not interfere on bread acceptability in a positive manner, actually the sample which has the lowest quantity of ginger powder i.e. 3% exhibited the greatest value of overall acceptableness. This inference differs from the one reported by Shalini & Lakshami, (2005) who discovered that bread having 10% of ginger showed good acceptability .This evident disagreement stands possibly by dint of the differences of dietary plan that exist between the various population under test. In our experiments garlic was used instead of ginger and its pungent taste was mainly due to organosulphur components, possibly effected the judgment .The amount of these active constituents in the dry garlic is minutely lower when compared with the fresh one, whereas the concentration of shogaols from ginger enhanced because the latter are composed from the similar gingerol during heat processing (Ali et al., 2008).

It was studied by Yadav et al. (2010) that the samples of wheat flour contain different amounts of bran and have a negative influence($p \leq 0.05$) on peak viscosity, break down and final viscosity ,on the other hand in oat bran had a positive ($p \leq 0.05$) effect on set back and final viscosity. If the garlic extract in liquid form is added at percentages from zero to nine percent, it will markedly alter dough machinability, viscoelasticity and bread making performance .The dough which had the greatest amount of garlic extract i.e. 9% depicted the peak readings for elastic modulus found by basic rheological measuring. It was proved by the results that dough handling and bread rheological properties remain unchanged if garlic extract is added up to 3% in the bread formulation. Introduction of garlic extract in formulation significantly enhanced the total phenolic content and radical scavenging action of bread extracts. Consequently garlic, onion and ginger powder can be viewed as vital nutraceuticals.

It has been accounted by Ho et al.(2011) that if varying formulations of turmeric powder are used than it will have an effect on rheology of bread for instance when 8% of turmeric powder is incorporated then the crumb color of bread had the most low acceptability. Light yellow is the color of turmeric powder, when 2% of turmeric powder was unable to cause any change in the original color of bread made from wheat. Whereas if the turmeric powder is substituted up to 4% concentration then peak liking score is noticed for taste and overall acceptableness of bread. As far as other sensorial characteristics (aroma and texture) are concerned, it was also found that there exists no major statistics difference for all samples. Contrarily bread which had 6% to 8% turmeric in its composition was regarded comparatively of low quality, which is possibly due to the Inordinate quantities of volatiles and phenolic compounds because the taste character of food is adversely affected by these compounds (Drewnowski & Gomez, 2000).The information on precise dose of these phytochemicals is unavailable despite this various in vitro and in vivo investigations have been conducted to examine their biological effects .Summary have been prepared by Maheshwari et al. (2006) which include Numerous investigations that list the biological activities of curcumin in relation to antioxidant activity ,wound healing action ,modulation of angiogenesis and anti-cancer activity . More investigations are required to prove the health benefitting attributes in vivo, after its ingestion and complete digestion .For this reason it is crucial to select suitable quantity of liquid garlic extract and processing conditions in order to achieve healthy baked goods (which possess high level of antioxidants) without negatively effecting the rheological attributes of dough and also without posing any marked change in desired physical and sensory properties of the bread. Pertaining to this more advanced and deep studies are presently under progress in our laboratory with a purpose to analyses the overall quality parameters of bread made with a garlic, ginger and onion concentrations of 3 to 4.5%.

Conclusions

Functional and nutraceutical foods and their diet base regimens are gaining popularity owing to number therapeutic applications and their safe utilization in various product developments. The health perspectives of these functional and nutraceutical foods are due to array of bioactive moieties. Garlic (Allium sativum L., Liliaceae.) is one of the essential vegetables used not only for culinary purposes but also in herbal remedies. Conclusively, in light of product development garlic bread was prepared with different concentrations of aqueous garlic extract. Aqueous garlic extract is a good source of phytochemicals like, antioxidants, phenols tannins along with strong profile of active ingredients. Phytochemical profile of aqueous garlic bread showed better antioxidant properties. Garlic bread containing all these active compounds may excellent source to curtail health related disorders with special perspectives to antioxidant, hypercholesterolemic and hyperglycemic potentials.

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