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Quality Attributes of Shamy Bread Supplemented With Cauliflower Wastes

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CAULIFLOWER Is one of vegetables rich in nutrients, but has the greatest waste index. The aim of this study was to investigate the possibility of partial substitution with 3 different concentrations of cauliflower wastes powder (CWP) to formulate novel functional Shamy bread. Proximate chemical composition, phenolic and flavonoids content, mineral content and functional properties were determined for the raw materials, whereas the sensory properties, freshness and microbial spoilage were estimated for bread. The CWP was superior in the most nutrients than wheat flour (WF). It is considered a rich source of minerals such as potassium (3462.69 mg/100g), calcium (750.40 mg/100g) and iron (37.85 mg/100g). Water Absorption Capacity (WAC) and Oil Absorption Capacity (OAC) for WF were increased from 0.68 (g/g) and 0.56 (g/g) to 1.84(g/g) and 0.98 (g/g), respectively by increasing CWP substitution level. Sensory evaluation of bread revealed that the fortified bread with CWP was not significantly different from the control (100% WF) at the general acceptability of all formulas but cauliflower flavor appeared slightly at formula containing 10% CWP. Additionally, the fortification with CWP helped to delay staling and microbial spoilage of bread from 345.20 to 261.92 and from 7.77 log (cfu/g) to 5.53 log (cfu/g) respectively. Resulting that extand shelf life of bread It could be concluded that the utilization the CWP in fortification of Shamy bread helped to improve nutritional value (protein, crude fiber and minerals), sensory properties and delay spoilage (staling or microbial) of bread without any cost of product due to its availability and inexpensive source

Keywords: Cauliflower wastes, Minerals, Functional properties, Sensory properties, Shamy bread, Shelf life.

Introduction

Recently, scientists paid the attention towards reusing wastes that generated during fruit and vegetable processing, which is an environmental and economic problem. On the other hand, these wastes are often rich in bioactive compounds such as antioxidants, dietary fiber, bioactive peptides and vitamins that can be utilized depending on their activity for diseases prevention and treatment such as (cardiovascular diseases, obesity, diabetes and cancer), as ingredients in conventional food products to convert to functional food products, as active agents for smart packaging or as cosmetic ingredients. The reusing of wastes can convert the produced wastes to be valuable materials that enhance product properties without any more in production costs and help with the waste disposal problem (Ranilla et al., 2010; Herrero et al., 2015).

Cauliflower (*Brassica oleracea* var. *Botrytis*) is a main member of *Brassicaceae* crops. It is well known that it generates huge quantities of wastes and secondary products during processing chain (Amofa-Diatuo et al., 2017). Cauliflower wastes are stems and leaves, which often consist 36-50% of the weight of the vegetable and it releases undesirable odor during decomposition. Therefore, the disposal of these wastes remains a crucial problem (Oberoi et al., 2007). Despite,

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Cauliflower wastes are considered as a rich source of dietary fiber that is characterized by possessing both anticarcinogenic and antioxidant properties. Furthermore, it is a good source of Phenolic compounds and vitamin C. Especially, these are the main antioxidants of brassica vegetables, due to high activity as antioxidants and their high content (Podsedek, 2007). Additionally, it is considered an excellent source of minerals and protein, especially leaf protein (Puupponen-Pimia et al., 2003 ;Wang et al., 2013).

Bread is a staple food in many countries and it usually plays an important role in human nutrition because it provides nutrients and energy (Dziki et al., 2014). Flat bread is known by many names such as Arabic (Pita or Shamy) and Balady in Egypt, Bouri in Saudi Arabia, Souri in Libya and North Africa, Roti in Pakistan and Naan in India etc. (Khattab et al., 2012). It is well known that the bread is often eaten with every meal, especially in the Middle East. Therefore, the bread fortification is considered as a good way to increase the nutritional value in diet (Al-dmoor, 2012; Dziki et al., 2014).

In the past, scientific researchers have focused their attention towards on the edible part of cauliflower, which contains antioxidant and anti-carcinogenic compounds (Ahmed & Ali, 2013). Notwithstanding, the disposal of cauliflower wastes remains an important challenge (Oberoi et al., 2007).

To the best of our knowledge, cauliflower wastes powder (CWP) has never been used as a fortifier to produce bakery products. The purpose of the present study was to investigate the possibility of a partial substitution of WF with 5, 7.5 and 10% of CWP to formulate novel functional flat (Shamy) bread.

Materials and Methods

Materials

Commercial WF (72% extraction rate), active dry yeast (*Saccharomyces cerevisiae*) and salt (sodium chloride) were obtained from the local market, Alexandria, Egypt. All chemical reagents used to carry out the experiments were of analytical grade.

Methods

Preparation of cauliflower wastes powder (CWP)

Freshly cauliflower was purchased from local market, Alexandria, Egypt. The cauliflower was separated into edible portions (the florets) and non-edible portions (stem, stalks and main midribs).

The inedible parts were used to act as cauliflower wastes. The cauliflower wastes were washed and then blanched in a hot water solution of cumin (*Cuminum cyminum*) seeds at 90±2 ºc for 60 sec. to reduce cauliflower flavor and inhibit the enzymes that hydrolyze bioactive compounds. The blanched cauliflower wastes were immediately cooled in cold water and drained. After cooling, the sample was chopped with a sharp stainless knife into almost equal small pieces. The sample was dried in hot air oven at 45-50 °C overnight to a final moisture content of 7-10%. Finally, the dried sample was milled and sieved with a mesh of size 0.50 mm. The dried powder was packed in clean brown bottles that tightly closed and kept at room temperature until use.

Preparation of CWP flat bread

Flat (Shamy) bread was prepared according to the method of (Yaseen & Shouk, 2011). Bread was prepared by partial replacement of WF (72% extraction rate) with CWP at levels 5, 7.5 and 10% to formulate different formulas. Flour of every formula was mixed with other ingredients (0.5% active dry yeast, 1.5% salt and water added to formula as needed) in mixer bowl. The dough was kneaded and then kept at room temperature for 30 min. to ferment. The fermented dough was cut and flattened into loaves, which were baked at 400–450°C for 60–180 second. The loaves were left to cool for about 60 minutes then wrapped in polyethylene bags to use for analysis.

Analytical Methods

Chemical composition

Moisture, lipids, ash, crude protein and crude fiber of WF, CWP and their formulas were determined according to the method of AOAC (2000). Total carbohydrates were calculated by difference.

Total phenolics content and total flavonoids content

Raw materials (WF and CWP) content of total phenolics and total flavonoids were determined. Total polyphenol content was determined according to the modified Folin–Ciocalteu colorimetric method as the method described by Dewanto et al. (2002) the absorbance at 760 nm using a spectrophotometer (Heλios, England). Gallic acid was used as standard. The results were expressed as mg of Gallic acid equivalents per gram of dry weight (mg GAE/g d.w.).Total flavonoids content was estimated as described by Dewanto et al. (2002). The absorbance of the samples was read at 510 nm using a spectrophotometer. The results were expressed as mg CATE/g of dry matter using catechin calibration curve.

Functional properties of flour formulas

Bulk density (Bd), Water Absorption Capacity (WAC) and Oil Absorption Capacity (OAC) were estimated for flour formulas as functional properties that affect the usefulness of ingredients in food (Ferreira et al., 2015). Bd was measured by using the method of Kaur et al. (2013). WAC and OAC were determined as described method by Ferreira et al. (2015).

Minerals determination

Minerals (sodium, potassium, calcium, phosphorus, magnesium, manganese, iron, zinc, copper and sulfur) content of WF and CWP were determined by using a SHIMADZU atomic absorption spectroscopy AA-6800 according to the methods of AOAC (2000).

Evaluation of bread quality

Sensory properties

Organoleptic characteristics of bread were carried out after cooling loaves at room temperature for 60 minutes. Sensory evaluation was performed by 10 panelists (staff members and graduate students of Food Sci. Dept., Faculty Agric. Saba basha, Alexandria Univ., Egypt). General appearance, crust color, crumb color, texture, odor, taste, easy of chewing and overall acceptability were evaluated through the nine-point hedonic (from like extremely = 9 to dislike extremely = 1) scale according to Quail et al. (1990).

Freshness of bread

Loaves freshness of flat bread was carried out after bread packaging in polyethylene bags and storage at room temperature (20±3 °C) for 0, 24, 72 and 96 hr. using alkaline water retention capacity test (AWRC) as described by Kitterman & Rubenthaler (1971).

Microbiological analysis of bread

The microbiological quality of bread samples was examined in triplicate during 0, 24, 48, 72 and 96 hours of stored bread at ambient temperature (20±3 °C). It was assessed by enumerating molds and yeasts by using Rose-Bengal Chloramphenicol Agar Base medium (Oxoid) and pour plated and incubated at 25 °C for 5 days as described by Needham et al. (2005). Microbial counts were expressed as logarithms of the number of colony-forming unit (log cfu/g).

Statistical analysis

Data were subjected to analysis of variance using the System (SAS) Program (SAS Institute, Carey, NC). Significant difference was at $P \leq 0.05$ (SAS, 1999). Results were presented as means ± standard deviation of three experiments.

Results and Discussion

Proximate chemical composition of raw materials and their formulas

The results in Table 1 show the proximate compositions of WF, CWP as raw materials and their formulas fortified with different levels of CWP (5, 7.5 and 10 %). It could be observed that CWP was superior it's in content of crude protein, lipids, ash and fibers than WF and thereby fortification of WF with CWP enhances the previous constituents in prepared formulas.

The presented data were in agreement with those obtained by Oberoi et al., (2008); Thilagam et al. (2013). In the light of the data presented here, the CWP is considered as a good source of protein, minerals and fiber. Consequently, the fortification of food with CWP is a good way to improve nutritional value of product and produce functional foods.

TABLE 1. Proximate chemical composition of raw materials and their formulas

			CWP level in blends		
Constituents (%)	**WF***	**CWP**	**5%**	**7.5%**	**10%**
Moisture	10.08**±0.12	7.29±0.04	9.84±0.01	9.76±0.00	9.70±0.01
Crude protein	10.97±0.25	17.37±0.61	11.29±0.38	11.46±0.55	11.62±0.56
Lipids	1.47±0.11	5.29±0.04	1.66±0.08	1.75±0.10	1.85±0.10
Ash	0.44±0.10	11.45±0.06	0.99±0.12	1.28±0.10	1.53±0.09
Total fiber	0.53±0.11	11.88±0.17	1.08±0.03	1.36±0.12	1.65±0.11
Carbohydrates***	76.41	46.56	75.15	74.41	73.66

* WF= wheat flour (72% extr.) and CWP= cauliflower wastes powder.

**Mean of three replicates ± SD on dry weight basis.

*** Available carbohydrate calculated by difference.

The content of total Phenolics and total Flavonoids

The health promoting phytochemicals such as total phenolic and total flavonoids, which are antioxidant compounds and naturally occurred in plants, were determined, as shown in Table 2. The CWP content of total phenolic and total flavonoid were 26.68 mg GAE/g and 18.41 mg CATE/g respectively, whereas the WF content of them were 0.37 mg GAE/g and 0.08 mg CATE/g respectively. It was noted that the content of both total phenolic and total flavonoid of CWP were greatly higher than WF. This may be attributed to WF was free of bran which is rich with phenolic compounds. The obtained results are in accordance with those presented by (Yu & Nanguet, 2013) who found that mostly, refined wheat flour is free from wheat bran fractions and thereby lower in polyphenolic content. Moreover, our results of this study are in agreement with those obtained by (Abul-Fadl, 2012) who noticed that white cauliflower by-products powders were rich of the phenolic compounds and flavonoids compounds. From our findings, it could be observed that CWP is considered as a rich source of phenolic and flavonoids compounds, which having a numerous beneficial effect on human health.

Functional properties

It is worth to mention that the functional properties of dietary fibers have the major effect on their function's foods. The functional properties of WF and its formulas with CWP are given in (Fig. 1). It can be observed that Bd values ranged from 0.76 to 0.82 g/cm^3. The control sample showed the lowest Bd values, whereas the blend fortified with 10% CWP showed the highest. The level of CWP fortification revealed a significant effect ($P \leq 0.05$) on Bd values of producing bread. Bd usually depends on dry matter content and distribution of particle size. Generally, a high Bd flour is good for food preparation (Chandra & Samsher, 2013).

The WAC (water absorption capacity) of different samples ranged from 0.68 to 1.84 g/g (Fig. 1). It was noted that with an increase in the amount of CWP the WAC of blends increased. It could be noted that WAC values increased significantly ($P \leq 0.05$) by increasing the level of CWP fortification. This may be attributed to CWP is rich with protein and crude fiber. Protein has both hydrophobic and hydrophilic proteins and thereby they can bind with water in foods. Dietary fiber exhibited with a highly efficient for holding water. The trends obtained to the effect of CWP fortification level on WAC values in this study were in consistence with those given by (Abul-Fadl, 2012) who found that WAC values was increased with increasing of replacement level of white cauliflower by-product powders in tasted beef sausage.

OAC is an important parameter as it improves mouthfeel and retaining of flavour of foods (Kaushal et al., 2012). The OAC of WF and its formulas with CWP are varied from 0.56 to 0.98 g/g (Fig. 1). The formula fortified with 10%CWP exhibited the highest OAC values, whereas the control sample exhibited the lowest. The values of OAC among tested samples showed significant differences ($P \leq 0.05$).

However, the increasing of OAC with increasing fortification with CWP may be due to the ability of the flour protein to physically bind fat and also the efficiency of dietary fiber fraction which have been shown highly efficiency to oil holding capacity. Our findings in the current study were in accordance with those reported by (Abul-Fadl, 2012) who found that OAI values was increased with increasing of replacement level of white cauliflower by-product powders in tasted beef sausage. Generally, that food quality is associated with both WAC and OAC and thereby they are important functional properties.

Mineral contents of WF and CWP

Minerals are very important for many biological processes in the human body, such as the action of the structural systems, nervous system, water balance and other cellular processes (Ameh et al., 2013).

TABLE 2. Total phenolic content and total flavonoid content in WF and CWP dry matter ([*]Mean ± SD).

Materials tested[*]	Total phenolic content (mg GAE/g)	Total flavonoid content (mg CATE/g)
WF[**]	0.37±0.10	0.08±0.03
CWP	26.68±0.84	18.41±0.26

[*] Mean ± SD: mean of triplicate determinations for testing component.

[**] WF= wheat flour (72% extr.) and CWP= cauliflower wastes powder.

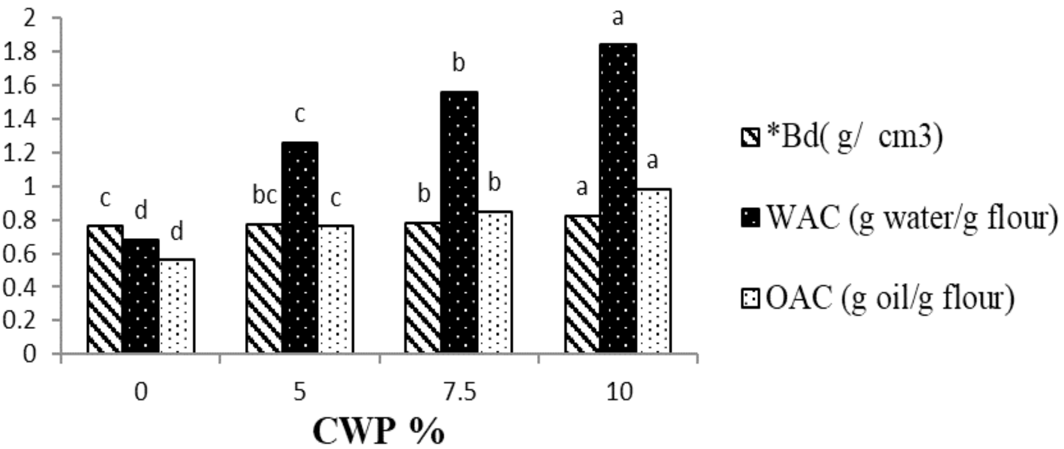

Fig. 1. Functional properties of WF and its formulas with CWP at levels (5, 7.5 and 10 %)

***Bd= bulk density, WAC= water absorption capacity, OAC= oil absorption capacity, WF= wheat flour (72% extr.) and CWP= cauliflower wastes powder**

****Means in the same columns with different superscript letters are significantly different (P≤0.05)**

The results of the mineral contents of raw materials (WF and CWP) are displayed in Table 3. It could be observed that CWP was superior in terms of mineral content of the most minerals than WF. The CWP is considered a rich source of potassium (3462.69 mg/100g) followed by calcium (750.40 mg/100g) as macro-elements and iron (37.85 mg/100g) as micro-elements.

These findings could be related to the refined WF usually is used for made bakery products, which is characterized with removal the outer layers, including the hull, bran and germ, which are richer in ash, bioactive compounds and minerals. Therefore, it should be fortification of WF with other raw material to produce bakery products with high levels of minerals and other bioactive compounds.

Aforementioned results of CWP are in agreement with (Oberoi et al., 2008). From the current results, it can conclude that the fortification flat bread (Shamy) with CWP will result in elevating the content of minerals in bread. Especially the lack of intake of minerals has been correlated with severe malnutrition, increased disease conditions and mental impairment (Abulude, 2005).

Sensory properties of flat bread

Assessment of flat bread quality by sensory evaluation is greatly based on subjective qualitative evaluation and personal judgment; the results may reflect the influences of consumer preferences. The effects of different level of fortification with CWP on the sensory attributes (General appearance, crust color, crumb color, texture, odor, taste, easy of chewing and overall acceptability) of control flat bread and flat bread containing CWP are shown in Table 4. It could be noted that the incorporation of CWP in bread caused of decreased the mean scores for odor and taste which ranged from 8.4 to 6.6 and from 8.4 to 7.0 respectively comparing to the control bread (8.8 and 8.6 respectively). On the other hand, the CWP bread characterized by improving in easy of chewing (8.4-8.6) and texture (8.0-8.6), which was significantly different ($p \leq 0.05$) comparing the control bread (7.4 and 7.4, respectively).

It could be noticed that the improving of texture and easy of chewing of bread by increasing fortification with CWP may be attributed to the CWP is considered a rich source of dietary fiber.

The trends obtained of the effect of replacement WF with CWP on bread sensory evaluation in this study were in agreement with those reported by (Sivam et al., 2011) who found that addition the apple pectin to dough the produced bread was softer and they attributed this to high the moisture content of bread. Moreover, the obtained results for odor and taste of fortified bread with CWP are in concordance with those of (Stojceska et al., 2008) who found that ready-to-eat expanded products could be fortified by addition cauliflower by-products up to the level of 10 %, but addition more than 10% level resulted in too strong flavor.

TABLE 3. Mineral contents of WF and CWP (mg/100 g)

Mineral contents	WF*	CWP
Macroelements		
Na	19.56**±0.94	548.01±0.55
K	93.37±2.27	3462.69±0.13
Ca	16.80±1.57	750.40±0.84
P	107.17±0.26	259.71±0.28
S	141.50±1.50	684.75±0.12
Mg	119.68±0.74	114.03±0.21
Microelements		
Fe	1.96±0.03	37.85±0.09
Zn	0.50±0.02	23.45±0.03
Mn	0.66±0.02	0.14±0.11

*WF= wheat flour and CWP= cauliflower wastes powder
**Mean of three replicates ± SD on dry weight basis

TABLE 4. Sensory evaluation of flat (Shamy) bread fortified with different concentrations of CWP.

Sensory evaluation	B1*	B2	B3	B4
Appearance	9^{a**}	9^{a}	8^{a}	8^{a}
Crust color	9^{a}	9^{a}	9^{a}	9^{a}
Texture	7.4^{b}	8.0^{ab}	8.4^{a}	8.6^{a}
Easy of chewing	7.4^{b}	8.4^{a}	8.4^{a}	8.6^{a}
Odor	8.8^{a}	8.4^{a}	8.0^{a}	6.6^{b}
Taste	8.6^{a}	8.0^{a}	7.8^{ab}	7.0^{b}
Crump color	9^{a}	9^{a}	9^{a}	9^{a}
General acceptance	8.5^{a}	8.5^{a}	8.4^{a}	8.1^{a}

*B1= control (0.0% CWP), B2, B3 and b4 =contained 5, 7.5 and 10 % CWP= cauliflower wastes powder, respectively
**Means in the same row with different superscript letters are significantly different ($P\leq0.05$)

Therefore, from the current results, it can be concluded that the fortified flat bread with (5-7.5%) of CWP had good quality and acceptability characteristics.

Freshness of flat (Shamy) bread

Alkaline water retention capacity (AWRC) is a quick and simple test and it can be used to follow freshness (staling) of bread. Higher values of AWRC mean higher freshness of the bread. The effect of different formulas of CWP bread on staling is revealed in Table 5. It could be noticed that the formulas of fortified bread with CWP remained softer during storage up to 72 hours than did the control bread. The level of CWP incorporation revealed a significant effect ($P\leq0.05$) on staling values of the fortified bread. On the other hand, the staling rate was increased by extending the storage time. This means that the samples of CWP bread were more freshness than control bread. This may be related to the CWP bread characterized with high in retaining the moisture content than control bread that due to CWP is considered rich in dietary fiber which have a good efficiency in retaining water. CWP is considered a rich source of dietary fiber, which has anti-oxidant and anti-carcinogenic properties (Podsędek, 2007). The aforementioned results of this study are in agreement with those of (Sidhu et al., 1997) who found that AWRC % of fresh Arabic bread was reduced after 4 days of storage.

Microbial assessment of flat bread

The potency of CWP in reduction of microbial growth (mold and yeast count) of stored bread at ambient temperature is shown in Fig. 2. It could be respected that the microbial growth of mold/ yeast was lower in CWP bread than control. The

TABLE 5. Effect of storage periods at room temperature on the freshness of flat (Shamy) breads supplemented with different concentrations of CWP.

Blends	Freshness (%)				Loss in freshness (%)		
	Storage period (h)				Storage period (h)		
	0	24	72	96	24	72	96
B1*	345.20^{c**}	303.61^{d}	243.10^{c}	*Nd****	12.05^{a}	32.19^{a}	*Nd*
B2	378.36^{b}	346.69^{c}	283.76^{b}	225.33^{b}	8.37^{ab}	25.01^{b}	34.77^{a}
B3	385.25^{ab}	359.75^{b}	294.92^{ab}	255.18^{a}	6.35^{b}	23.20^{b}	32.56^{a}
B4	391.33^{a}	371.58^{a}	302.40^{a}	261.92^{a}	5.40^{c}	22.72^{b}	31.83^{a}

*B1= control (0.0% CWP), B2, B3 and b4 =contained 5, 7.5 and 10 % CWP= cauliflower wastes powder, respectively.
** Means in the same row with different superscript letters are significantly different (*P*□0.05).
*** *nd*= not determined because of spoilage

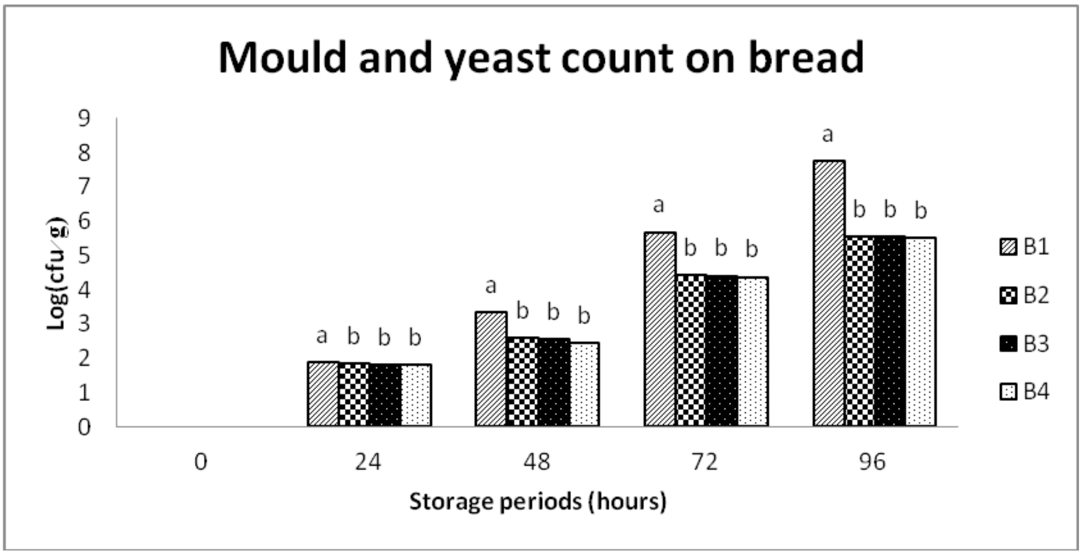

Fig. 2. Total yeast/mold count of bread samples during storage at ambient temperature.
*B1= control (0.0% CWP), B2, B3 and b4 =contained 5, 7.5 and 10 % CWP respectively
**Means in the same columns with different superscript letters are significantly different (p≤.05)

microbial load in bread increased with extension days of storage. Fresh bread at zero time, the Yeast/mold were not detected, this might be due to baking temperature (400-450 ºC), which might have eliminated all microbes in the dough (Adeboye et al., 2015). The CWP effectiveness against yeast/mold growth was helped to elongate bread shelf life from 3 days for the control sample to 4 days for fortified bread with CWP. End storage period for bread samples stored at ambient temperature, the microbial load of control bread sample (WF 100%) reduced from 7.77 log (cfu/g) to 5.53 log (cfu/g) as the bread CWP levels increase. This may be due to CWP a rich in flavonoids or have the potential to provide antifungal compounds. Knekt et al. (1996) who found that flavonoids exhibit antioxidant and antimicrobial properties and have ability to lower the risk of cardiovascular diseases.

Unfortunately, the performed studies to investigate the effect of cauliflower wastes as an antifungal in food are scarce. However, some studies have been conducted on its effect as antibacterial against *Salmonella spp*. And *E. Coli spp* in food (Brandi et al., 2006) and *Listeria monocytogenes* (Sanz-Puig et al., 2015).

Conclusion

From the presented results, it can be concluded that flat (Shamy) bread can be improved by replacing WF at 5 and 7.5% of CWP such replacing helped to improve the nutritional value, functional properties, sensory characteristics and elongation the shelf-life of bread without increasing in the cost of the product. Especially, this product does not yet exist in the market. Moreover, utilization of the anti-fungal compounds of cauliflower wastes for food deserves more researches.

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خصائص جودة خبز الشامى المدعم بمخلفات القنبيط

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يعتبر القنبيط من الخضروات الغنية بالمغذيات ، ولكنه ينتج قدر كبير من المخلفات. لذا كان الهدف من هذه الدراسة هو التحقق من إمكانية الاستبدال الجزئي باستخدام ثلاث مستويات تركيز مختلفة من مسحوق مخلفات القنبيط (CWP) لصنع خبز شامى وظيفي جديد. تم اجراء تحاليل لتقدير التركيب الكيميائي التقريبي و المحتوى الفينول والفلافونويد و المحتوى المعدني والخصائص الوظيفية للمواد الخام ، بينما تم اجراء تقدير الخواص الحسية و درجة الطزاجة ومدة الصلاحية (الفساد الميكروبي) للخبز الناتج . اظهر مسحوق القنبيط (CWP)تفوقًا في معظم العناصر الغذائية عن دقيق القمح (WF) كما انه يعتبر مصدرا غنيا بالمعادن مثل البوتاسيوم (3462.69 مجم / 100 جرام) والكالسيوم (750.40 مجم / 100 جرام) والحديد (37.85 مجم / 100 جرام).بالنسبة للخصائص الوظيفية حدثت زيادة في سعة امتصاص الماء (WAC) وسعة امتصاص الزيت (OAC) لدقيق القمح (WF) من 0.68 (جم / جم) و 0.56 (جم / جم) إلى 1.84 (جم / جم) و 0.98 (جم / جم) ، على التوالي وذلك نتيجة لزيادة مستوى الاستبدال باستخدام CWP . أظهر التقييم الحسي للخبز أن الخبز المدعم بـ CWP لم يكن مختلفًا بشكل كبير عن العينة الكنترول(WF 100%) في القبول العام لجميع الخلطات ولكن ظهرت نكهة القنبيط قليلاً عند الخلطة المحتوية على 10٪ CWP بالإضافة إلى ذلك ، ساعد التدعيم باستخدام CWP في تأخير تجلد الخبز وفساده الميكروبي. وعليه يمكن استنتاج ان استخدام CWP في تدعيم الخبز المسطح (الشامى) ساعد على تحسين القيمة التغذوية (البروتين والألياف الخام والمعادن) والخصائص الحسية و تاخير الفساد(تجلد وميكروبي) للخبز الناتج دون زيادة في تكلفة للمنتج لانه متاح بدون ثمن.