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Abstract:

The present work aims to study the effect of partial replacement of whole wheat flour with vegetable and fruit waste powder at a concentration of (5% and 10%) on the rheological, sensory, chemical and microbiological properties of raw materials and toast bread. The results of the chemical composition of raw materials showed an increase in the content of fiber, fat, ash, protein and antioxidant compounds in the powder of vegetable and fruit waste. While, wheat flour recorded the highest content of moisture and carbohydrates. Forms were prepared to evaluate the sensory properties of toast bread and select the best samples to be studied and analyzed. The results of the chemical composition of the fortified bread samples showed an increase in the content of fiber, fat, protein and moisture compared to the control bread. The farinograph data showed increased water absorption and degree of softening as compared with control sample (100% wheat flour) and decreased in stability, arrival time and dough development. Extensograph results showed increased in elasticity, extensibility, proportional number and energy of the mixed dough compared to the control. Microbiological analysis showed that adding vegetable and fruit waste to toast bread controlled the growth of bacteria, yeast and molds during the storage period. Hence, it is recommended to use these vegetable and fruit waste powder to raise the nutritional value of products.

Key words: Toast bread, turnip leaves, cabbage leaves and prickly pear peels rheology properties, chemical, microbiological analysis.

دراسات تكنولوجية وكيميائية على الخبز المدعم بمخلفات الخضروات والفاكهة

الملخص العربى:

تهدف الدراسة الحالية إلى دراسة تأثير الإستبدال الجزئى لدقيق القمح الكامل بمسحوق مخلفات الخضروات والفاكهة بتركيز ٥%، ١٠% على الخصائص الريولوجية والحسية والتركيب الكيميائى للمواد الخام وخبز التوست المدعم. تم استخدام مسحوق قشور التين الشوكى، أوراق الكرنب الخارجية، أوراق اللفت. أظهرت نتائج التركيب الكيميائى للمواد الخام زيادة فى المحتوى من الألياف والدهون والرماد والبروتين والمركبات المضاده للاكسده فى مسحوق مخلفات الخضروات والفاكهة. بينما سجل دقيق القمح أعلى محتوى من الرطوبة والكربوهيدرات. أعدت استمارات لتحكيم الخواص الحسية لخبز التوست المدعم. واختيار افضل العينات لتكون محل الدراسة وأجريت التحاليل الكيميائية والريولوجية عليها . سجلت نتائج التركيب الكيميائى اعلى محتوى من الالياف والدهون والبروتين والرطوبة فى عينات الخبز المدعمة بالمقارنة بعينه التحكم. أوضحت نتائج الفارينوجراف للعجائن المخلوطة زيادة فى كل من امتصاص الماء ودرجة المرونة بالمقارنة مع العينة الضابطة (١٠٠% دقيق قمح) وانخفاض فى الثبات ووقت الوصول والوقت اللازم لتطوير العجين فى العجائن المخلوطة. بينما أظهرت نتائج الإكسنسوجراف زيادة فى المرونة والتمدد والرقم النسبى والطاقة للعجائن المخلوطة.أظهرت نتائج التحليل الميكروبى أن إضافة مسحوق مخلفات الخضر والفاكهة تحكم فى نمو البكتريا والخمائر والعفن خلال فترة التخزين. ومن ثم يوصى بإستخدامها فى انتاج خبز ذو قيمة غذائية عالية.

1. Introduction

Food processing waste is a low-cost raw material for extracting beneficial compounds like dietary fiber, natural antioxidants, and natural food additives. Furthermore, fruit and vegetable waste and byproducts are often discarded at a loss to the producer **(Al-Weshahy, and Rao, 2012).** In the food industry, waste is attributed to the high product-specific waste ratio. This not only means that the production of this waste is inevitable, but also that if the quality of the finished product is to remain constant, the quantity and form of waste produced, which mainly consists of organic residues of manufactured raw materials, can scarcely be altered **(Mashal, 2016).**

Bread is the main dietary source in many countries; however, wheat bread is the most popular due to its textural and sensory properties according **(Ngozi (2014).** Nowadays, consumers increasingly require foods with functional properties. To meet consumer health requirements, the use of functional ingredients in bread formulations is increasingly expanding in the bakery industry as part of bread nutritional improvement as reporting by **(Alam *et al*., 2013).**

Fruit and vegetable powder is abundant in fiber, protein, and minerals, as well as having a large water and oil holding capacity. As a result, it may be utilized in a new low-calorie and cost products **(Ferreira *et al*., 2013).**

Bread is a food product that is universally accepted as a very convenient form of food that has desirability to all population rich and poor, rural and urban. It is still one of the most consumed and acceptable staple in all parts of the world **(Mannay and Shadaksharaswany, 2005).**

Turnip **(*Brassica rapavar.rapa L*.)** is considered one of the oldest cultivated vegetables that have been used for human nutrition, folk medicines and food technology (**Liang *et al*., 2006 and Thiruvengadam *et al.* 2014**). It's belonging to the family of Brassicaceae which are widely consumed all over the world and have more attention because it has phytochemical components which play good role in human nutrition **(Akhlaghiand Bandy, 2010).** Roots, leaves, stems and flower buds are considered edible parts **(Fernandes *et al*., 2007**). In Egypt, a turnip root only is usually used for nutrition but nowadays leaves also become used in making traditional dishes. Many studies revealed that high consumption of cruciferous vegetables significantly reduces the risk of certain types cancer and cardiovascular diseases, because it have phytochemical components which appeare antioxidant, antimicrobial and anticancer activity **(Thiruvengadam and Chung, 2015- Ibrahim *et al.* (2014)**.

Prickly pear fruit is a berry that weighs between 100 and 200 grams and has a thick fleshy skin or peel (30-40% of total fruit weight) and a high sugar content (10% of total rind weight) **(Ali, 2001)**. Polysaccharides (21%), cellulose (29.1%), hemicelluloses (8.5%), pectin (3%), protein (8.3%), and minerals (12.13%) were all found in significant amounts in prickly pear peel **(El-Kossori**, ***et al*, 1998).** Prickly pear is a particularly rich plant in vitamins, minerals, amino acids, and carbohydrates, according to several studies. It has been utilized in meals, medical purposes, cosmetics, and the manufacturing of cochineal **(Stintzing and Scheiber, 2003). Elhassaneen *et al*. (2016a)** also discovered that prickly pear peels are a good source of dietary fiber as well as bioactive components including carotenoids and phenolics.

The objective of the present study was to determine the chemical composition, antioxidant, rheological properties and sensory evaluation of bread supplemented with some vegetable and fruit wastes at different ratios.

2. Materials and Methods

Materials:

Turnip leaves, Cabbage leaves and Prickly pear peels were obtained from the local market, Elsharkia Governorate, Egypt in July.

Wheat flour:

Wheat flour (82% extraction) was obtained from Mills Company, Zagazig, Egypt.

Additives materials:

Sugar, salt and fresh compressed yeast were obtained from the local market, Zagazig, Egypt.

Methods

Preparation of waste powders:

Cabbage, turnip leaves and prickly pear peels were cleaned well, washed with running water, cut into small slices and dried at (0- 60 ° C) by oven drying fan model super serving science center laboratory for soil, food, feed stuff faculty of Technology and development–Zagazig university for 2 days. Then, ground it with an electric mixer and sieve it through a fine silk sieve. Powder was collected in bags and stored in a deep freezer at 18 ° C until analysis and use.

Technological process

Preparation of different blends of toast bread:

Blends of bread were prepared using wheat flour 82% extraction as control and that supplemented with 5% and 10% of cabbage, turnip leaves powder and prickly pear peels powders. These blends formulation were presented in table (1).

Baking process of Toast bread:

Toast bread baking using the straight method was carried out as described by **Lazaridou *et al*., (2007)**. Bread dough was baked at 240°C for 20-25 min. in an electric oven. The resulted toast bread samples were allowed to cool at room temperature for 2 hours before being packed in polyethylene bags and stored at room temperature for further examinations.

Table (1): Blends components of wheat flour and its mixtures containing cabbage, turnip leaves and prickly pear peels powder for bread dough

Samples No.	**Blends %**			
	WF	**Cabbage leaves powder**	**Turnip leaves powder**	**Prickly pear peel powder**
Control	100	-	-	-
T1	95	5	-	-
T2	90	10	-	-
T3	95	-	5	-
T4	90	-	10	-
T5	95	-	-	5
T6	90	-	-	10

Control: Wheat flour (82% ext.) T1: WF+ 5% cabbage leaves powder, T2:WF+ 10% cabbage leaves powder, T3: WF+5% turnip leaves powder, T4: WF+ 10% turnip leaves powder, T5: WF+ 5% prickly peels powder and T6: WF+10%prickly peels powder.

Sensory Evaluation:

Toast bread was cooled for 1-2 at room temperature (25º C) in sealed plastic bag. The toast bread was then cut into 2×3×5 cm slices using a bread knife. Sensory properties were evaluated for crust color, irregular shape, crumb color, crumb hardness, taste and flavor, overall acceptability as described by **AACC (2005).**

Statistical analysis

Statistical Analysis The results are recorded as mean ± SD and subjected to analysis of variance (ANOVA) for a completely randomized design using a statistical analysis system.Comparison among means were performed using the LSD test. The differences were considered significant at the 5% level ($p \leq 0.05$) by using (Costat version 6.311,1998-2005).

Analytical Methods:

Chemical composition of raw materials and processed toast bread samples:

Determination of moisture, crude ash, fat, crude fiber, protein and total carbohydrates were performed according to the International Standard Methods **(ISO).** Moisture content was according to **ISO** 5462/ 2006, Crude ash according to ISO 5464 / 2006, Crude protein according to **ISO** 5465-1/2006, Crude fat according to EN 26.2L54/37 Volume. 52/2009 and Crude fiber were determined according to EN 26.2L54/40 Volume. 52/2009. Total carbohydrate contents of samples were determined by the difference, according to the equation of **(Chatffieled and Admas, 1940).**

HPLC analysis

HPLC analysis was carried out using an Agilent 1260 series. The separation was carried out using Zorbax Eclipse Plus C8 column (4.6 mm x 250 mm i.d.,5 μm). The mobile phase consisted of water (A) and 0.05% trifluoroacetic acid in acetonitrile (B) at a flow rate 0.9 ml/min. The mobile phase was programmed consecutively in a linear gradient as follows: 0 min (82% A); 0–1 min (82% A); 1-11 min (75% A); 11-18 min (60% A); 18-22 min (82% A) ; 22-24 min (82% A). The multi-wavelength detector was monitored at 280 nm. The injection volume was 5 μl for each of the sample solutions. The column temperature was maintained at 40 °C.

Determination of total flavonoid content (TFC)

Modified AlCl3 calorimetric method was used,1 ml of extract were dissolved in 2 ml of methanol in a 10 ml of volumetric flask. 5% NaNO3, 5% NaOH and 7% AlCl3 solution were prepared by using water in a 25 ml of volumetric flask. 200 microliters of extract were taken in a sealed glass vial and added 75 µl of 5% $NaNO_3$ and left for 5 min at room temperature. Later on 1.25 ml of $AlCl_3$ and 0.5 ml NaOH were added to each vial. Then it was sonicated and incubated for 5 min at room temperature .After incubation, the absorbance of all working solution and standard solution was measured against methanol blank at 510 nm. The flavonoids content of extracts was estimated by using the quercetin standard calibration curve and the obtained results of flavonoids were expressed as microgram of quercetin equivalent (Qu) per 1 g of dry extract **(Chang, *et al* 2002- Marinova, *et al*, 2005).**

Determination of the total phenolic content

Total phenolic content of the extracts were evaluated by a colorimetric method utilizing Folin-Ciocalteu reagent. 1 ml of extract were dissolved in 2 ml of methanol, 500µL aliquots of extract were mixed with 2.5 mL Folin–Ciocalteu reagent (diluted ten-fold) and 2.5 mL (75 g/L) sodium carbonate. The tubes were vortexed for 10 sec and allowed to stand for 2 hr at 25 oC. After incubation at 25 °C for 2 hr, absorbance was measured at 765 nm against reagent blank . Total phenolic content was expressed as milligrams of gallic acid equivalent (GAE) per gm (**Marinova, *et al*, 2005- Sembiring *et al*, 2018)**.

Rheological parameters:

The rheological measurements were carried out for each above mentioned flour portions under investigation using farinograph and extensographe were tested rheological laboratory department of bread and dough, food technology research institute, Giza – Egypt according to the standard methods of **A.A.C.C (2000).**

Enumeration of microorganisms in bread

Ten milliliters of each sample was mixed with 90 mL of 0.85% (NaCl: W/V) sterile physiological saline to make an initial dilution (10−1). Serial dilutions were made for each sample, and 1.0 mL of the appropriate dilutions (10−2, 10−3, 10−4, 10−5, 10−6, and 10−7) was poured and plated according to the type of bacterial group in triplicates on media as follow:

Plate count agar (PCA; Merck, 1.05463) was incubated at 370C for 48 hr. to enumerate the total bacterial count according to **(APHA, 1978)**.

Yeasts and moulds were determined on Rose Bengal Chloramphenicol Agar (RBCA: Lab M, 36 supplemented with chloramphenicol X009), incubated at 30◦C for five days according to **(Atlas, 2004)**.

Coliform bacteria (*E. coli*) were determined on violet-red bile Agar (VRBA; Biolife, Italy) with a double layer of the same medium. The plates were incubated at 37◦C for 24 hr., respectively according to the method of **(Atlas, 2004)**.

Determination of counts of *Staphylococcus aureus*: Mannitol salt Agar (MSA) was used to determine the counts of Staphylococcus aureus in bread and flour samples. The suspected colonies of S. aureus showed a yellow colour for mannitol fermentation and a yellow halo for coagulase production around the colony. Suspected colonies were further confirmed by catalase, coagulase tests, and Gram staining technique (13). Typical S. aureus colonies were counted to calculate per gram of sample described by **(Cappuccino and Sherman 1996).**

Counts of *Bacillus cereus* in bread were determined as follows: Samples (10 g) were placed in sterile flasks containing 90 mL of saline. The flasks were carefully shaken and then treated for 30 seconds with a sterile electric mixer to eliminate the aggregates, and the suspensions were heat-treated for 20 minutes at 70 °C. After heating, 0–1 ml of 10-fold dilutions of each sample were plated on Mueller Hinton agar by **(Mueller and Hinton, 1941)** ((Oxoid, Basingstoke, UK) (three plates for each dilution) and incubated for 24 h at 37 °C. The number of Bacillus colonies forming units was counted per gram of flour.

Candida albicans

Candida albicans was isolated from bread using methods indicated by **Erkmen (2022)**. Each isolated yeast colony was transferred into 8 mL of de Man Rogosa-Sharp broth (MRS broth; Difco, Detroit) and 8 mL of potato dextrose broth (PDB; Difco, Detroit), respectively, and incubated anaerobically aerobically for yeast at 28 ◦C for 48 and 72 h. Then, the isolates were counted by streak plating on the respective Petri plates.

Pseudomonas aeruginosa

Conventional Pseudomonas aeruginosa detection methods are based on the biological characteristics of the bacterium under specific culture conditions, such as Gram-negative or Gram-positive status. Pseudomonas aeruginosa can produce ammonia as a nutrient by breaking down acetamide, an ability that is absent in other bacteria. Based on this mechanism, **Tang *et al.* (2017)** have detected media containing acetamide as a carbon source of P. aeruginosa. This media has been described as a modified Simmons Citrate Agar using acetamide as the sole carbon source. Various modified Simmons agar formulations have been used to survey the ability of various nonfermenting gram-negative bacteria to deaminate acetamide. A few species were found to be capable. P. aeruginosa most actively accomplished acetamide deamination. A pronounced blue reaction in the medium indicates the alkalization that occurs with deamination.

3. Results and Discussions

Chemical Composition of Raw Materials

Chemical composition of raw materials (wheat flour 82% extraction, cabbage leaves outer, turnip leaves and prickly pears peels were presented in table (2). The results showed that wheat flour had the highest values of moisture and carbohydrates (11.44% and 69.73 %).but it contains lower amounts of fiber (4.19%), fat(1.56%) and ash (1.58%) compared to other materials.

Turnip leaves powder contains the highest values of ash (20.26%) and protein (26.0%), while prickly pear peels had the lowest protein value (4.5%).

Cabbage leaves powder contained the highest value of fiber (18.26%), followed by turnip leave (12.92%), and then prickly pear peels powder (12.44%).

The results showed that no significant difference were found between TLP and PPP in moisture, fiber and fat (5.66% and 5.28%), (12.92% and 12.44%) and (2.05% and 2.21%) respectively. These results are in agreement with **(Mohamed, *et al,* 2024)** who reported that the chemical composition of wheat flour composed of moisture 11.03%, protein 12.60%, ash 0.56% but differences in carbohydrates 84% and fiber 0.43%. On the other hand, our results agreed with these of **(salwa, *et al,* 2023)** who studied that moisture prickly pear peels content 4.27%, ash 10.97% and protein 6.48%. Also, our results agreed with **(Rania, *et al,* 2017).**

Table 2: Chemical Composition (% on dry weight basis) of wheat flour, Turnip leaves, prickly pear peels and cabbage leaves powder

Parameters	WF	TLP	PPP	CLP
Moisture (%)	11.44 ± 0.20	5.66±0.10	5.28 ± 0.09	6.61 ±0.11
Fiber (%)	4.19 ± 0.31	12.92 ± 0.96	12.44 ± 0.93	18.26 ±1.36
Fat (%)	1.56 ± 0.34	2.05 ± 0.07	2.21 ± 0.10	2.03 ± 0.10
Ash (%)	1.58 ± 0.01	20.26 ± 0.19	14.53 ± 0.14	16.13 ±0.15
Protein (%)	11.5 ± 0.44	26.0±0.99	4.5 ± 0.17	14.0 ±0.54
Carbohydrates (%)	69.73	33.11	61.04	42.97

Control: Wheat flour (82% ext.)   TPL: turnip leaves   PPP: prickly pear CLP: cabbage leaves

Phytochemical analysis:

Table (3) showed the phytochemicals included total phenolic and total flavonoid of TLP, CLP, and PPP. The results showed that TLP was the highest value of total phenolic (11.48 mg/g), followed by CLP (99.73 mg/g). while PPP was the lowest one (72.97 mg/g).

The highest content of total flavonoid was in TLP (36.18 mg/g), followed by CLP (32.36 mg/g), while PPP was the lowest (24.33mg/g).

Table 3: Total phenolic and total flavonoids of TLP, CLP and PPP

Phytochemicals	TLP	CLP	PPP
Total phenolic	117.48±1.078	99.73± 1.965	72.97± 1.308
Total flavonoid	36.18± 0.24	32.36± 0.724	24.33± 0.920

Sensory evaluation of toast bread supplemented with turnip leaves, cabbage leaves and prickly pear peels powder (TLP, CLP and PPP):

Food acceptability issues may be resolved with the use of organoleptic testing, which is also helpful for product development, quality control, and most importantly the enhancement of new goods (**Mohamed, 2018 - De Lamo, and Gómez, 2018- Albahlol, *et al* 2022).** Data presented in table (4) showed the sensory properties of toast bread which supplemented with different levels (5% and 10%) of turnip leaves (TLP), cabbage leaves (CLP) and prickly pear peels (PPP) powder in general appearance, crust color, crumb color, crumb distribution, taste, flavor, sponge and total score. Data showed that the best toast supplemented was in sample (T3) (86.55%) followed by (T1) sample (85%). Sample (T1) WF+ TLP recorded the highest score of general appearance, crust color, crumb color and crumb distribution while, sample (T3) WF+ PPP recorded the highest score of taste, flavor, sponge and total score. T1, T3, and T5 recorded a good acceptance compared with the control sample.

Table 4: sensory evaluation of toast bread supplemented with waste powder

Samples	General appearance (15)	Crust color (15)	Crumb color (15)	Crumb distribution (10)	Taste (15)	Flavor (15)	Sponge (15)	Total score (100)
Control	14.05[a] ± 0.89	14.02[a] ± 0.89	14.25[a] ± 0.91	9.1[a] ± 0.97	13.65[a] ± 1.60	14.2[a] ±1.00	14.05[a] ± 0.82	93.5[a] ± 4.15
T1	13.2 [ab] ± 1.51	13.2 [b] ± 1.73	13.2 [b] ± 1.73	8.5 [ab] ± 1.00	12.35[a] ± 2.06	12.5 [b] ± 1.96	12.32 [bc] ± 2.52	85 [b] ± 10.14
T2	10.95[c] ± 1.60	11.05[c] ± 1.36	11.2[c] ± 1.06	6.1 [c] ± 1.16	10.5 [b] ± 1.32	10.6 [c] ± 1.53	10.5 [de] ± 1.93	71.95 [c] ± 7.88
T3	13.05 [ab] ± 1.32	13.05 [b] ± 1.67	12.9 [b] ± 1.62	8.1 [b c] ± 1.29	12.65 [a] ± 1.81	13.3 [ab] ± 1.56	13.2ab ± 1.70	86.55 [b] ± 8.81
T4	12.2 [b] ± 2.09	12.55[b] ±2.04	12.6 [b] ± 2.06	7.95 [bc] ± 1.60	12.1 [a] ± 2.38	12.15 [b] ± 2.28	11.55 [cd] ±2.30	81.15 [b] ± 13.95
T5	12.05 [b] ± 1.35	12.5 [b] ± 1.47	12.5 [c] ± 1.47	7.4[c] ± 1.05	12.75 [a] ± 1.91	12.8 [b] ± 1.61	12.8 [abc] ± 1.40	83 [b] ± 8.03
T6	9.85d ± 1.75	10.45 [c] ± 1.05	10.45[c] ± 0.94	5.65[d] ± 1.18	9.8 [b] ± 1.24	9.6 [c] ± 1.43	10.05[e] ± 1.70	65.9[d] ± 2.17
LSD	0.97	1.63	1.86	1.60	0.1.53	1.07	1.21	8.91

Control: Wheat flour (82% ext.), T1: WF+ 5% turnip leaves powder, T2:WF+ 10% turnip leaves powder, T3: WF+5% prickly peels powder, T4: WF+ 10% prickly peels powder, T5: WF+5 % cabbage leaves powder and T6: WF+10%cabbage leaves powder.

Chemical composition of toast bread supplemented with turnip leaves, cabbage leaves and prickly pear peels powder:

Table (5) showed the values content of moisture, protein, ash, fiber, fat, carbohydrate, and energy. Moisture, fiber, ash, fat, and protein were increased in all samples of toast bread supplemented with TLP, PPP, and CLP compared with control. While, there was a decrease in carbohydrates and energy values.

The results showed that the toast bread supplemented with 5% turnip leaves powder (TLP) was the highest in fat, ash, and protein contents as it recorded (1.68, 2.83, and 8.0 %) respectively. There were no significant differences in ash content between the control bread and other supplemented toast bread.

Table 5: Chemical composition of supplemented toast bread

Samples	Moisture	Fiber	Fat	Ash	Protein	T.C	Energy
	%						**KCal / Kg**
Control	35.65±0.64	1.69±0.13	0.99±0.025	2.35±0.023	7.6±029	51.72	2839.1
TLP	38.11±0.69	2.37±0.18	1.68±0.041	2.83±0.027	8.0±0.30	47.01	2745.12
PPP	37.47±0.67	3.17±0.24	1.26±0.032	2.75±0027	7.6±0.29	47.75	2749.04
CLP	38.73±1.59	2.26±0.17	1.49±0.038	2.70±0.026	7.8±0.30	47.02	2712.7

Each value represents mean of three replicates± standard deviation

C: control 100% WF   TLP: 5% turnip leaves   PPP: 5% prickly pear peels   CLP: 5% cabbage leaves   T.C: total carbohydrates

Rheological properties of dough:

Farinograph parameters:

Table (6) shows the Farinograph test includes water absorption, dough development, arrival time, dough stability and degree of softening. The results which presented in Table (7) and Figure (1) illustrated all farinograph parameters for wheat and flour of wheat replaced for 5% turnip leaves powder, 5%cabbage leaves powder, and 5% prickly pear peels. The blending of vegetables and fruit by – products (TLP, CLP and PPP) in dough increased the water absorption from 67.5% for control to 68.7% and 69.2% for dough contained 5% TLP and PPP. Dough contained 5% (PPP) recorded the highest score while dough contained 5% (CLP) recorded the lowest score (65.4%). Arrival time was decreased from 7.0 min in control sample to 4.0 min in all blending. Also, the highest value of dough development was 9.0min in control sample. While it was lower in the dough mixed with TLP which recorded 6.0 min. The stability time was 11.0 min in control while it was lower in dough contained 5% TLP which recorded 5.0 min.

The dough softening degree of the control sample was 30 B.U, while the dough treatment increased the dough of softening degree as compared to the control. The dough contained 5%TLP was similar to dough contained 5% CLP in the same degree of softening that they recorded 90 B.U.

Table 6: Farinograph parameters of flour samples used in toast bread preparation

Samples	Water absorption (%)	Arrival time (min)	Dough development (min)	Dough stability (min)	Degree of softening (B.U)
C	67.5	7.0	9.0	11.0	30
TL	68.7	4.0	6.0	5.0	90
PP	69.2	4.0	8.0	8.5	70
CL	65.4	4.0	7.0	7.5	90

C: control 100% WF TL: 5% turnip leaves PP: 5% prickly pear
CL: 5% cabbage leaves

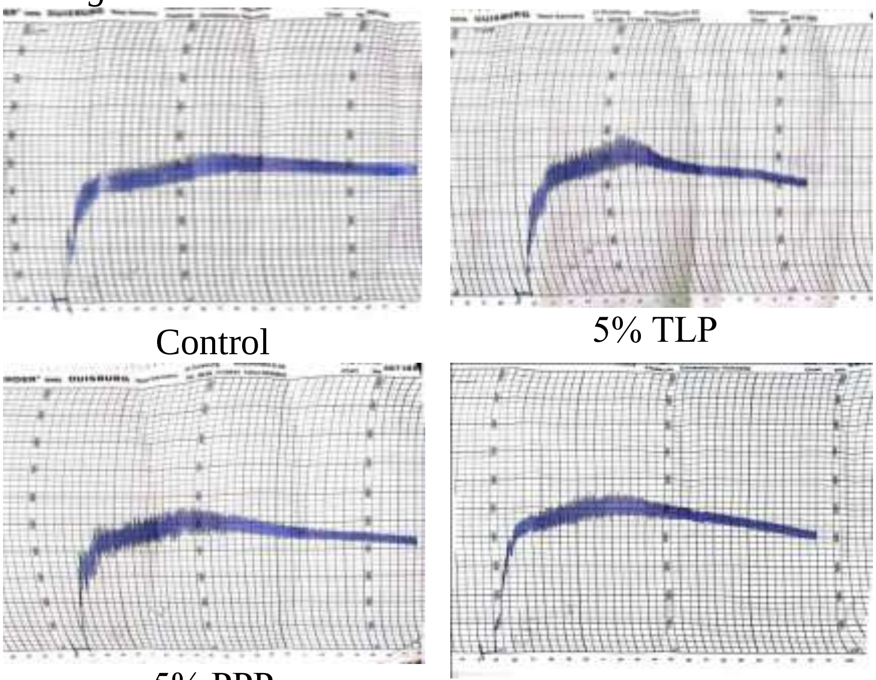

Figure1. C: control 100% WF, T1:5% turnip leaves, T2: 5% prickly pear , T3: 5% cabbage leaves

Extensograph Results:

Extensograph data of all dough samples are presented in Table (7). Figure 2 showed the elasticity, extensibility, proportional number, and energy. There was a clear difference in elasticity (B.U) between the control flour and the dough contains turnip leaves, cabbage leaves and prickly pear peels powder (TLP, CLP, and PPP). The dough contained

PPP (WF + 5%PPP) was recorded the highest value followed by (WF + 5% TLP), and (WF + 5% CLP) then control flour. The values were as follows 608 B.U, 560 B.U, 480 B.U, and 190 B.U respectively.

The control sample was similar to dough mixed with TLP in the same dough extensibility that they recorder (40 mm), whereas the extensibility for dough mixed with CLP was recorded the highest value (55 mm). Proportional number of blends scored the highest values compared to the control sample. The highest value was in dough mixed with TLP followed by dough mixed with PPP and dough mixed with CLP registered 14, 13.33, and 8.72 P.N.

Energy of blends increased from 10 cm^2 in control sample to 30 cm^2 in CLP. The dough mixed with TLP was similar to dough mixed with PPP in the same energy that they recorded (25 cm^2).

Table 7: Farinograph parameters of flour samples used in toast bread preparation

Samples	Elasticity (BU)	Extensibility (mm)	Proportional Number (P.N)	Energy (cm2)
C	190	40	4.75	10
T1	560	40	14	25
T2	608	45	13.33	25
T3	480	55	8.72	30

C: control 100% WF T1:5% turnip leaves T2: 5% prickly pear T3: 5% cabbage leaves

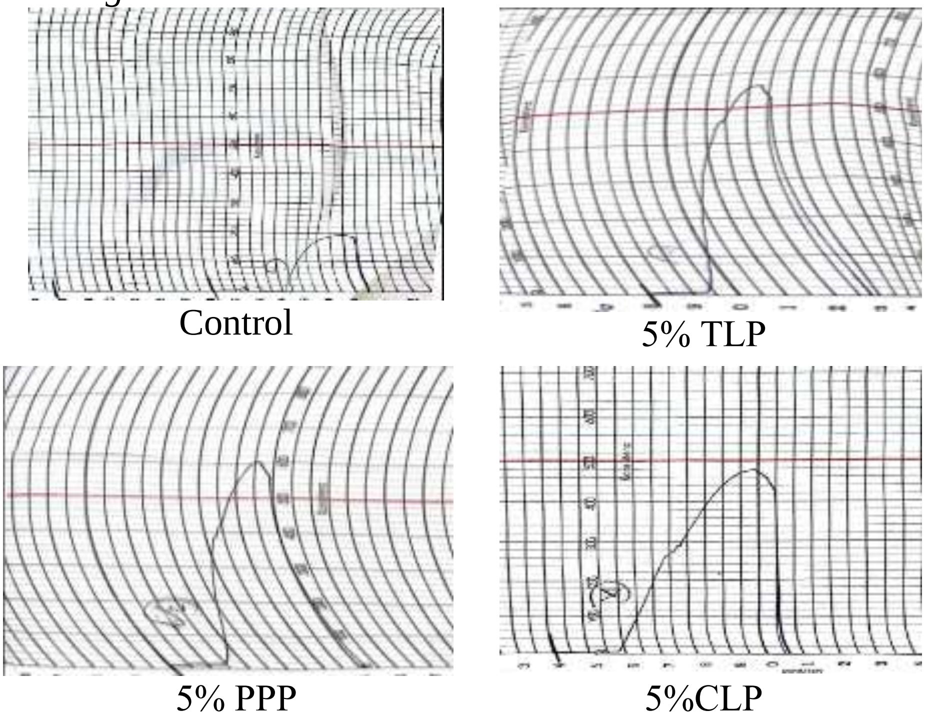

Figure 2: C: control 100% WF, T1:5% turnip leaves, T2: 5% prickly pear ,T3: 5% cabbage leaves

The count of microorganisms in toast bread

Table (8) represents the variation of bacterial counts of coloured bread with different concentrations of 5% Turnip leaves, 5 % prickly pear peel, and 5 % Cabbage leaves. The total bacterial count, yeasts, and moulds decreased, with a rise in concentration compared to the control. the total bacterial count (cfu/mL) at the zero-day bacterial count ranged from 0.99 to 1.65 compared to the control 1.99 x 10^4. In 21 days, the 5% Cabbage leaves extract gave a lower bacteria count (0.96×10^4) than the control (1.86×10^4). Yeasts and moulds at 21 days ranged from 0.1 to 0.7 compared to the control (0.9×10^2). In 21 days, the 2% extract and 5 % Cabbage leaves gave a small count of yeasts and moulds. *Escherichia coli* were not found in all samples during 0, 3, 7, and 21 days, which is excellent evidence of the high quality of bread.

Table (8): Total viable count, yeasts and moulds and *E. coli* count in colored toast bread with different extracts during 21 days

Concentration (g/100 g)	A- Total count of bacteria No.× 10 ^{4} CFU.			
	zero-day	**7-day**	**14-day**	**21-day**
Control	1.99	1.88	1.87	1.86
5% Turnip leaves	1.65	1.64	1.62	1.60
5 % prickly pear peel	1.19	1.18	1.17	1.16
5 % Cabbage leaves	0.99	0.98	0.97	0.96
	B- Yeasts and moulds No.× **10** ^{2} CFU.			
Control	1.3	1.2	1.1	0.9
5% Turnip leaves	0.9	0.9	0.8	0.7
5 % prickly pear peel	0.6	0.6	0.7	0.6
5 % Cabbage leaves	0.4	0.3	0.2	0.1
	C- *E. coli* No.× **10** $^{(1-6)}$ CFU.			
Control	N	N	N	N
5% Turnip leaves	N	N	N	N
5 % prickly pear peel	N	N	N	N
5 % Cabbage leaves	N	N	N	N
* N: **negative**				

Table (9) represents the variation of bacterial counts of coloured bread with different concentrations of 5% Turnip leaves, 5% prickly pear peel, and 5% Cabbage leaves. *Staphylococcus aureus*, *Candida albicans*, and *Pseudomonas aeruginosa* were not found in all samples during 0, 3, 7, and 21 days, which is excellent evidence of the bread's high quality. The results are in the same line as those of **Arrais *et al.* (2022)** who reported that the cabbage extract showed a statistically higher inhibition effect against S. aureus (Gram-positive bacteria). Extract from cabbages tested for their antibacterial and antifungal properties. They perform well against two Candida species and a Pseudomonas aeruginosa, Klebsiella pneumoniae and Staphylococcus aureus reference-strain blend.

Table (9). *Staphylococcus aureus, bacillus, candida albicans,* and *Pseudomonas aeruginosa* count in coloured bread with different extracts during 21 days

Concentration (g/100 g)	A- ***Staphylococcus aureus*** **No.** × **10** [6] CFU.			
	zero-day	**7-day**	**14-day**	**21-day**
Control	N*	N	N	N
5% Turnip leaves	N	N	N	N
5 % prickly pear peel	N	N	N	N
5 % Cabbage leaves	N	N	N	N
	B- ***Bacillus cereus*** No. × **10** [4] CFU.			
Control	N*	N	N	N
5% Turnip leaves	N	N	N	N
5 % prickly pear peel	N	N	N	N
5 % Cabbage leaves	N	N	N	N
	C- ***Candida albicans*** No. × **10** [4] CFU.			
Control	N	N	N	N
5% Turnip leaves	N	N	N	N
5 % prickly pear peel	N	N	N	N
5 % Cabbage leaves	N	N	N	N
	D- ***Pseudomonas aeruginosa*** No. × **10** [4] CFU.			
Control	N	N	N	N
5% Turnip leaves	N	N	N	N
5 % prickly pear peel	N	N	N	N
5 % Cabbage leaves	N	N	N	N
* N: negative				

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