Effect of Substitution Wheat Flour with Psyllium Seeds Powder on Biscuit Quality Traits

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ABSTRACT:

The objective of this research was to assess the impact of substitution wheat flour (WF) with psyllium *(plantago ovate)* seed powder (PSP) at 0, 3,6, and 9% levels on the chemical, rheological and organoleptic properties of flour, doughs and produced biscuits. The substitution of WF with PSP significantly increased the contents of crude fiber, ash, protein, fat from 0.58,1.91,6.92 and 15.27%,respectively for control to 1.39,2.28,7.7 and 15.52%, respectively for biscuit sample produced from flour blend that contains 9%PSP, whereas it decreased the corresponding carbohydrates content from 70.76% to 68.23%.The results showed that the Partial substitution of WF with PSP increased water absorption, arrival time and dough development time, while decreased dough extensibility. Also, the substitution wheat flour with (PSP) led to increment of dough elasticity and energy. The results illustrated that protein content was increased from 6.92% for control to 7.54, 7.62 and 7.70% for 3PSP%, 6PSP% and 9PSP%, respectively. The same trend was also noted with crude fiber content which was increased from 0.58 % for control to0.78,1.16 and 1.39%for 3PSP%,6PSP% and9 PSP%, respectively .The substitution of WF with PSP resulted in decreasing the diameter of biscuit from 4.36 cm for control to 4.22, 4.10 and 4.06 cm for 3%, 6% and 9%PSP, respectively. The substitution of WF with PSP adversely affected all sensory properties of biscuit, since it decreased with increasing the substitution level. The results it could be noted that biscuit sample formulated with substituting WF with 9% PSP was had the lowest sensorial value for all sensory properties but still acceptable.

Key words: psyllium; biscuit; Rheological properties.

INTRODUCTION

The demand for functional foods is increasing around the world due to the significant increase in non-communicable diseases, including cardiovascular disease (CVD), cancer, diabetes and high blood pressure. Therefore, novel functional ingredients are tested to determine if they are suitable for use in the development of functional foods and if they are appropriate. In this context, Psyllium is a member of the genus Plantago, which is made up of more than 200 species. Amongst them, *Plantago ovata* is known for its versatile uses that is commonly grown (Dhar *et al*., 2005). Psyllium contains polysaccharides which are well known for its health benefits besides its antioxidant and gelling properties which are due to the high levels of branched acid arabinoxylan (Guo *et al*., 2008). Psyllium seeds are a potential source of bioactive compounds, including polyphenols and flavonoids, which provide tremendous health benefits (Talukder *et al.*, 2016). Psyllium (*Plantago ovata*) seeds that have high contents of soluble, insoluble fibers and phytochemicals will be considered as functional ingredient in processing foods and beverages (Pejcz *et al*., 2018).

Biscuits are among the most frequently consumed pastry products. Their popularity is due to their availability, long shelf life and, above all, the richness of their diversity, both in terms of appearance and taste. Biscuit dough can be made from ingredients such as flour, fat, sugar, milk, eggs, salt, starch, cocoa, retention agents, emulsifiers and essences (Tireki, 2008).

Currently, the main objective is to enrich pastry products with ingredients rich in protein, fiber, vitamins and antioxidant compounds (Pasqualone *et al*., 2014, Chauhan *et al*.,2015, Krystyjan *et al*., 2015a, Mesías *et al*., 2016), Čukelj *et al*. ,2017 and Korus *et al*., 2017, and reduce their energy value by removing or replacing fats (Laguna *et al*.,2012, Rodríguez-García *et al*.,2013 and Krystyjan *et al*.,2015a) and sugar (Savitha *et al*.,2008 and Aggarwal *et al*.,2016).

So, the objective of this research is to assess the impact of supplementation wheat flour (WF) with psyllium *(plantago ovate)* seed powder (PSP) at 0, 3, 6, and 9% levels on the chemical, rheological and organoleptic properties of the prepared flours, doughs and produced biscuits.

MATERIALS AND METHODS.

Materials:

Psyllium seeds: seeds of (*Plantago ovate*) were obtained from Agriculture Research Center, Giza, Egypt.

Baking Materials: Wheat flour 72% (WF), white sugar, shortening, sodium chloride, sodium bicarbonate, ammonium bicarbonate, glucose, lime and skimmed milk powder were purchased from local market from Tanta city, Gharbiya governorate, Egypt.

Chemicals and reagents: All chemicals and reagent were purchased from El-Gomhoria Company for chemicals and Drugs, Tanta city, Egypt.

Methods:

Preparation of psyllium seed powder:

The seeds were ground into fine particles using a Kenwood blender to obtain psyllium seed powder (PSP). The produced PSP was kept in airtight containers and stored at (–18 ^{o} C) until further analysis and using.

Preparation of Wheat flour/ psyllium seed powder (PSP) blends:

Wheat flour/PSP blends were prepared by replacing wheat flour by PSP with levels of 0 % PSP (Control WF only), 3% PSP (97WF/3PSP), 6% PSP (94WF/6PSP) and 9% PSP (91WF/9PSP).

Preparation of biscuit:

Biscuit was prepared according to the formula presented in Table (1) by using the method described by Hashem *et al*. (2004) as follows: sugar, shortening, skimmed milk powder, and glucose were creamed in a mixer for 8 min. Sodium bicarbonate, sodium chloride and ammonium bicarbonate were dissolved in water then added to the cream and mixed for 3 min till homogenous cream formed. Sieved flour was added to the cream and mixed for 2 min. The dough pieces were sheeted and baked at 230°C for 7 min. After baking, biscuits were left at room temperature to cool, then wrapped tightly with plastic packs and stored at room temperature until analysis.

Chemical analysis:

Wheat flour (WF), psyllium seed flour (PSF), and biscuit were analyzed for moisture, crude protein, ash, crude ether extract and crude fiber according to the methods of AOAC (2010). Available carbohydrates were calculated by difference by using the following equation.

% Available carbohydrates = 100 – % (moisture + protein + ash + ether extract +crude fiber)

Caloric value: Caloric value were calculated according to FAO (2002) by using the following equation:

Caloric value (kcal/100g) = (% carbohydrate × 4.1) + (% protein×4.1) + (% fat× 9.1)

Determination of minerals: Minerals were determined according to the methods of AOAC (2010).

Rheological properties of dough:

Rheological properties of wheat flour (WF) and wheat flour/psyllium seed powder (WF/PSP) were estimated by Brabender Farinograph (Water absorption (%), Arrival time , Dough development (min , Dough stability (min) , Softening of dough , Peak high (BU)) and Extensograph apparatus (Extensibility (cm) , Resistance to extension (BU) , Maximum elasticity(BU) , Area (Cm3) , Proportional number) according to AACC (2012)

Farinograph parameters:

Farinograph parameters which include water absorption, arrival time (min), stability time, dough development (min) and weakening (BU) of tested flours were determined using Farinograph (Barabender Corporation Rochelle Prak. N. J. made in U.S.A.), according to the methods as described by AACC (2010)

Extensograph parameters:

Extensograph parameters which include elasticity (B.U), extensibility (mm), proportional number and area (cm^2) of tested flours were determined using Extensograph (Barabender Corporation Rochelle Prak. N. J. made in U.S.A.), according to the methods as described by AA0CC (2010).

Color measurements:

The colour attributes Hunter L, a, b and H values were recorded using spectro colorimeter (Tristimulus Colour Machine) with the CIE lab color scale (Hunter, Lab Scan XE - Reston VA, USA) in the reflection mode. L* defines lightness, a* denotes the red/green value and b* the yellow/blue value

Sensory Evaluation:

Sensory evaluation was performed by 10 panelists from the Department of Food Science and Technology. Samples were randomly assigned to each panelist. Panelists were asked to rate the biscuit samples for appearance, Color, Texture, Oder, Taste, and Overall acceptability at 10-point scale.

Statistical Analysis:

The results were statistically analyzed by analysis of variances described by SPSS, (1997). Significant differences among individual means were analyzed by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The proximate compositions of wheat flour (72%) and psyllium seeds powder.

The chemical composition of foods is an indicator on its nutritional value. Table (2) showed the proximate chemical composition of wheat flour and Psyllium seeds powder (PSP). The results showed that psyllium seeds powder (PSP) had considerably higher protein, fat, ash and crude fiber contents, 16.57, 5.03, 3.64 and 16.89%, respectively than that of wheat flour, 11.18, 1.02, 0.71 and 0.76%, respectively. The results also showed that PSP had higher insoluble and insoluble fiber (13.07and3.8 2 %) than WF (0.41and 0.35%). In the contrary, wheat flour had higher total carbohydrates (74.32%) than psyllium seeds powder (46.37%). Also, the caloric value of wheat flour was higher than that of psyllium seeds powder since it recorded 351.18 and 297.03 respectively. These results were similar to that obtained by Romero-Baranzini, *et al*. (2006) and Moawad *et al.* (2019).

Minerals content of wheat flour (72%) and psyllium seeds powder (mg/100g) on dry weight base.

Minerals content of a food is very important since it reveals its content from these important micronutrients. On the context, psyllium seeds powder contains high minerals content (El-Hadidy, 2020). Table (3) showed the minerals content of psyllium seeds powder and wheat flour. The results indicated that psyllium seeds powder had higher Potassium content (738 mg/100 g) than wheat flour (172). Also, PSP contains higher level of phosphorus (650 mg/100g) as compared to wheat flour which contains 145 mg/100g. On the contrary, wheat flour contains higher magnesium and sodium contents, 120.20 and 39.89mg/100g, respectively as compared to 97.80 and 33.10 mg/100g respectively for PSP. In general, PSP also contains higher contents from calcium, iron, manganese and zinc which recorded: 145, 18.3, 2.8 and 4.2 mg/100 g, respectively as compared to 54.46, 1.49, 1.76 and 0.48 mg/100g respectively for wheat flour. These results were on the line with that reported by (Ghani et al., 2016).

Effect of substitution wheat flour with psyllium seeds powder on rheological properties of dough:

Farinograph parameters:

Table (4) showed Farinograph parameters of wheat flour and wheat flour /Psyllium seed powder blends. From these results, it could be observed that Water absorption (%) is increased as the wheat flour substitution with PSP level increased since it recorded the following values, 59.28, 61.8, 63.6 and 65.2 % for control, 3PSP%, 6PSP% and 9PSP%, respectively.

Similarly, the addition of PSP to WF led to increase the arrival time as the substitution level is increased (0.6,0.65, 0.71, 0.76 min) for control, 3PSP%, 6PSP% and 9PSP%, respectively, also dough development was recorded the following values, 1.8, 2.1, 2.9, 3.5 min for control, 3PSP%, 6PSP% and 9PSP%, respectively. The same trend was observed with dough stability which exhibited gradually increasing with increasing the substitution level of WF with PSP as follows 10.0, 10.41, 11.8and 13.2min for control, 3PSP%, 6PSP% and 9PSP%, respectively.

On the other hand, softening of dough (B. U) was decreased with increasing the substitution level of WF with PSP, since it decreased from 38 B.U for control to38, 35, and 24 B.U for 3PSP%, 6PSP% and 9PSP%, respectively. Similarly, peak high was decreased with increasing the substitution level of WF with PSP, since it decreased from 69 B.U for control to 60.80, 54.20and 50.10 B.U for 3PSP%, 6PSP% and 9PSP%, respectively.

The high capacity of water absorption of psyllium seeds powder may be due to the molecular structure of psyllium seeds, 75% xylose, 23% arabinose and 35% of non-reducing terminal remains (Fischer *et al.*, 2004).

Extensograph parameters:

The extensograph parameters were illustrated in Table (4). The results revealed that the substitution of WF with psyllium seeds powder (PSP) resulted in decreasing the dough extensibility (cm) from 130 cm for control to 120, 105 and 85cm for 3PSP%, 6PSP% and 9PSP%, respectively. Whereas the substitution of WF with PSP was increased the other extensograph parameters since it led to increment in the dough resistance to extension from 225for control to 340, 420and 600 B.U for 3PSP%, 6PSP% and 9PSP%, respectively. Also, the dough maximum elasticity was increased from 1.68for control to 1.82, 2.08and 2.82B.Ufor 3PSP%, 6PSP% and 9PSP%, respectively. Similarly, the area (Cm3) was increased from48 for control to 52, 66, and 78 Cm^2 for 3PSP%, 6PSP% and 9PSP%, respectively. The same trend was noted for the proportional number which is increased from 1.76 for control to 3.4, 5.3 and 7.5for 3PSP%, 6PSP% and 9PSP%, respectively (Pejcz and Burešová, 2022 and El- Hadidy, 2020).

Effect of substitution wheat flour with psyllium seeds powder on color attributes of biscuits:

The color attributes of the biscuit are factories affecting consumption capacity. The data in Table (5) show that the substitution of WF with PSP significantly darkened the color of biscuit samples as compared to control. L^* values were decreased by increasing the substitution level since it recorded the following values; 70.87, 70.66, 70.23 and 70.09 for control, 3PSP%, 6PSP% and 9PSP%, respectively. On the other hand, the values of A^*, B^* and A/B were increased by the increasing the substitution level of WF with PSP levels which is on the line with the findings of Ziemichód *et al*. (2018).

Effect of substitution wheat flour with psyllium seeds powder on chemical composition and energy value of biscuit.

Table (6) shows the chemical composition and caloric value of the biscuit fabricated with substitution of wheat flour with 0, 3%, 6% and 9% of PSF. The results indicated that crude protein, total fat, crude fiber and ash contents of biscuit samples were increased significantly with increasing the WF substitution level with PSP. The results illustrated that protein content was increased from 6.92% for control to 7.54, 7.62 and 7.70% for 3PSP%, 6PSP% and 9PSP%, respectively. Also, fat content was increased from 15.27% for control to 15.38, 15.41 and 15.52 % for 3PSP%, 6PSP% and 9PSP%, respectively. Similarly, the ash content of biscuit was increased from 1.91% for control to 2.15, 2.21 and 2.28% for 3PSP%, 6PSP% and 9PSP%, respectively. The same trend was also noted with crude fiber content which was increased from 0.58 % for control to 0.78, 1.16 and 1.39% for 3PSP%, 6PSP% and 9PSP%, respectively. On the other side, the carbohydrate content decreased from 70.76% to 69.33, 68.76and 68.23% for 3PSP%, 6PSP% and 9PSP%, respectively. Also, the energy decreased from 448.15to 445.9, 444.21 and 443.4 Kcal/100g for 3PSP%, 6PSP% and 9PSP%, respectively which agreed with the results of El-Hadidy (2020).

Effect of substitution wheat flour with psyllium seeds powder on physical traits of biscuit:

Table (7) shows that the substitution of WF with PSP resulted in decreasing the diameter of biscuit from 4.36 cm for control to 4.22, 4.10 and 4.06 cm for 3PSP%, 6PSP% and 9PSP%, respectively, while the thickness of biscuit is increased with increasing the substitution level of WF with PSP since it increased from 0.85 for control to 0.92, 0.98 and 1.01 for 3PSP%, 6PSP% and 9PSP%, respectively. Also, the spread ratio of biscuit was decreased from 5.13 for control to 4.59, 4.18, and 4.02. For 3PSP%, 6PSP% and 9PSP%, respectively.

Effect of substitution wheat flour with Psyllium seeds powder on sensory evaluation of biscuit:

Table (8) shows that the substitution of WF with PSP adversely affected all sensory properties of biscuit, since it decreased with increasing the substitution level, where there were significant differences between control and biscuit samples formulated with substitution of WF with PSP. The results showed that the appearance sensory score of the biscuits was decreased from 8.86 control sample to 8.57, 7.71 and 6.86 for 3PSP%, 6PSP% and 9PSP%, respectively. Also, the score of color decreased from 9.00 for control to 8.29, 7.86 and 7.86 for 3PSP%, 6PSP% and 9PSP%, respectively. The reason for the difference in color is due to the color of the PSP, which was a shade of gray and significantly affected the overall color of the dough and biscuits. The same was observed with texture which is decreased 8.14 for control to 8.29, 7.86 and 7.29 for 3PSP%, 6PSP% and 9PSP%, respectively. Similarly, the odor value was decreased from 9.00 for control to 8.1, 7.86 and 7.71 for 3PSP%, 6PSP% and 9PSP%, respectively. Regarding taste, it decreased from 8.57 for control to 8.00, 7.71 and 7.43 for 3PSP%, 6PSP% and 9PSP%, respectively. This trend is reflected on the overall acceptability which was decreased from 8.71 for control sample to 8.26, 7.8 and 7.43 for 3PSP%, 6PSP% and 9PSP%, respectively. The obtained results were in agreement with that reported by El-Hadidy (2020). From the results, it could be noted that biscuit sample formulated with substituting WF with 9% PSP had the lowest sensorial value for all sensory properties but still acceptable.

CONCLUSION

Finally, it could be concluded that psyllium powder can be incorporated in biscuit formulas as a substitute of wheat flour up to 9% without affecting the rheological and sensory properties with improving the nutritional value.

REFERENCES

AOAC 2010: Association of Official Analytical Chemists. Official Method of Analysis, 19th Edition, Washington, D. C. United States of America.

AACC 2010: AACC Approved Methods .St. paul, Minnesota, USA: CS, Kuri V, Tudorica CM (2004). Inulin-enriched pasta: effects on textural properties and starch degradation. Food Chemstry.86(2):189-193.

AACC. 2012: International Methods approved of the American Association of Cereal Chemists, 11th ed., American Association of Cereal Chemists, INC., St. Paul, Minnesota, USA.

Aggarwal, D., Sabikhi, L., Kumar, M.H.S. 2016: Formulation of reduced-calorie biscuits using artificial sweeteners and fat replacer with dairy–multigrain approach. NFS J. 2: 1-7.

Chauhan, A., Saxena, D., Singh, S. 2015: Total dietary fibre and antioxidant activity of gluten free cookies made from raw and germinated amaranth (*Amaranthus* spp.) flour. LWT-Food Sci Technol. 63(2): 939-945.

Čukelj, N., Novotni, D., Sarajlija, H., Drakula, S., Voučko, B., Ćurić, D. 2017: Flaxseed and multigrain mixtures in the development of functional biscuits. LWT-Food Sci Technol. 86: 85-92.

Dhar, M.K., Kaul, S., Sareen, S., Koul, A.K. 2005: *Plantago ovata*: Genetic diversity, cultivation, utilization and chemistry. Plant Genet Resour 3:252-63.

Duncan, D. 1955: Multiple range and multiple F test. Biometric, Edition ASSOC. Office . Anal Chem., Arlington 11: 1– 42 .

El-Hadidy, G.S. 2020: Preparation and Evaluation of Pan Bread Made with Wheat flour and Psyllium Seeds for Obese Patients. Current Science International, 9 (2) : 369-380.

FAO. 2002: Food energy. Methods of analysis and conversion factors. Food and Nutrition Paper 77. Report of a technical workshop, Rome 3-6 December. ISSN 0254-4725.

Fischer, H., Yu, N., Gray, G.R., Ralph, J., Anderson, L., Marletta, J.A. 2004: The gel forming polysaccharide of psyllium husk (*Plantago ovata* Forsk). Carbohydrate Research, 339: 2009–2017.

Ghani, A., Ameen, O., Ikram, M., Hussain, M., Ahmad, I., Khan, A. 2016: Proximate and elemental profile of *Plantago ovate*. Int Res 5:3-9.

Guo, Q., Cui, S.W., Wang, Q., Young, J. 2008: Fractionation and physicochemical characterization of *Psyllium gum*. Carbohydr Polym. 73:35-43.

Hashem ,H.A., Abou Alfadi, M.M. Nassar, A.G. 2004: Effect of replacement of wheat flour by Jerusalem artichoke flour on dough rehological properties and quality of biscuit produced. Bulletin of the National Institute cairo, Egypt,25:198-218.

Korus, A., Gumul, D., Krystyjan M., Korus, J. 2017: Evaluation of the quality, nutritional value and antioxidant activity of gluten-free biscuits made from corn-acorn flour or corn-hemp flour composites. Eur Food Res Technol. 243(8): 1429-1438.

Krystyjan, M., Gumul, D., Ziobro, R., Korus, A. 2015a: The fortification of biscuits with bee pollen and its effect on physicochemical and antioxidant properties in biscuits. LWT-Food Sci Technol. 63: 640-646.

Laguna, L., Varea, P., Salvador, A., Sanz, T., Fiszman, S.M. 2012: Balancing texture and other sensory features in reduced fat short-dough biscuits. J Texture Stud. 43: 235-245.

Mesías, M., Holgado, F., Márquez-Ruiz, G., Morales, F.J. 2016: Risk/benefit considerations of a new formulation of wheat-based biscuit supplemented with different amounts of chia flour. LWT-Food Sci Technol. 73: 528-535.

Moawad, E.M.M., Rizk, I.R.S., Kishk, Y.F.M., Youssif, M.R.G. 2019: Effect of substitution of wheat flour with quinoa flour on quality of pan bread and biscuit. Arab Univ. J. Agric. Sci. 26(7D), 2387- 2400

Pasqualone, A., Bianco, A.M., Paradiso, V.M., Summo, C., Gambacorta, G., Caponio, F. 2014: Physico-chemical, sensory and volatile profiles of biscuits enriched with grape marc extract. Food Res Int. 65: 385-393.

Pejcz, E., Burešová, I. 2022: Rheological Characteristics of Model Gluten-Free Dough with Plantago Seeds and Husk Incorporation. https://doi.org/ 10.3390 / foods 11040536 . 11, 536.

Pejcz, E., Spychaj, R., Budzisz, A., Gil, Z. 2018: The effect of Plantago seeds and husk on wheat dough and bread function properties. LWT -

Food Science and Technology, 96(2018) 371-377.

Rodríguez-García, J., Laguna, L., Puig, A., Salvador, A., Hernando, I. 2013: Effect of fat replacement by inulin on textural and structural properties of short dough biscuits. Food Bioprocess Technol. 6(10): 2739-2750.

Romero-Baranzini, A.L., Rodriguez, O.G., Yanez-Faries, G.A., Barrron-Hoyos, J.M., Rayas-Duarte, P. 2006: Chemical, Physicochemical, and Nutritional go (*Plantago ovata* Forsk). J Cereal Chem., 83(4):358-362.

Savitha, Y.S., Indrani, D., Prakash, J. 2008: Effect of replacement of sugar with sucralose and maltodextrin on rheological characteristics of wheat flour dough and quality of soft dough biscuits. J Texture Stud. 39: 605-616.

SPSS. 1997: Spss users Gide statistics version 8 Copy right Spss Inc., USA, Washington , D. C. USA

Talukder, P., Talapatra, S., Ghoshal, N., Sen Raychaudhuri, S. 2016: Antioxidant activity and high-performance liquid chromatographic analysis of phenolic compounds during *in vitro* callus culture of *Plantago ovate* Forsk and effect of exogenous additives on accumulation of phenolic compounds. J Sci Food Agric 96:232-44.

Tireki, S., Şumnu, S.G., Sahir, S. 2008: Technology of Cookie Production. In: (Eds). Food Engineering Aspects of Backing Sweet Goods. New York, CPC Press Taylor and Francis Group.

Ziemichód, A., Wójcik, M., Rózyło, R. 2018: Seeds of Plantago psyllium and Plantago ovata: Mineral composition, grinding, and use for gluten-free bread asnsubstitutes for hydrocolloids. J Food Process Eng., 2019, 42, e12931.

Table 1: Biscuit formula.

Ingredients	Quantity (g)
WF or WF/PSP *	100.00
Sugar	30.00
Shortening	25.00
Sodium chloride	1.00
Sodium bicarbonate	0.30
Ammonium bicarbonate	1.50
Skimmed milk powder	2.00
Glucose	2.00
Water	20.00

* WF = wheat flour, WF/PSP = wheat flour/psyllium seed powder blends.

Table 2: Physicochemical composition of wheat flour (72%) and psyllium seed powder.

Components	WF*	PSP**
Moisture	12.01	12.49
Protein	11.18	16.57
Fat	01.02	05.03
Ash	00.71	03.64
Crude fiber	00.76	16.89
Insoluble fiber	00.41	13.07
Soluble fiber	00.35	03.82
Carbohydrate	74.32	46.37
pH	05.92	05.86
Energy (kcal/ 100g)	351.18	297.03

*WF= wheat flour 72%, **PSP = psyllium seed powder.

Table 3: Minerals content of wheat flour (72%) and psyllium seed powder (mg/100g) on dry weight basis.

Components	WF*	PSP**
phosphorus (P)	145.20	650.00
magnesium (Mg)	120.20	97.80
potassium (K)	172.00	738.00
Sodium (Na)	39.89	33.10
calcium (Ca)	54.46	145.00
iron (Fe)	1.49	18.30
manganese (Mn)	1.76	2.80
Zinc (Zn)	0.48	4.20
Copper (Cu)	0.31	0.08
Nickle (Ni)	0.060	0.01

*WF= wheat flour 72%, **PSP = psyllium seed powder.

Table 4: Effect of substitution wheat flour with psyllium seeds powder on rheological properties of dough.

Treatments*	Control	3% PSP	6% PSP	9% PSP
Farinograph Parameters				
Water absorption (%)	59.28^{d}	61.80^{c}	63.60^{b}	65.20^{a}
Arrival time	00.60^{d}	00.65^{c}	00.71^{b}	00.76^{a}
Dough development (min	01.80^{d}	02.10^{c}	02.90^{b}	03.50^{a}
Dough stability (min)	10.00^{d}	10.41^{c}	11.80^{b}	13.20^{a}
Softening of dough	38.00^{a}	35.00^{b}	29.00^{c}	24.00^{d}
Peak high (BU)	69.00^{a}	60.80^{b}	54.20^{c}	50.10^{d}
Extensograph Parameters				
Extensibility (cm)	130.00^{a}	120.0^{b}	105.0^{c}	85.00^{d}
Risistance to extension (BU)	225.00^{a}	340.0^{c}	420.0^{b}	600.0^{a}
Maximum elasticity(BU)	001.68^{a}	01.82^{c}	02.08^{b}	02.82^{a}
Area (Cm3)	048.00^{d}	52.00^{c}	66.00^{b}	78.00^{a}
Proportional number	001.76^{d}	03.40^{c}	05.30^{b}	07.50^{a}

*Control =100% WF, 3% PSP = 97WF/3PSP, 6% PSP = 94WF/6PSP and 9% PSP = 91WF/9PS).

Table 5: Effect of substitution wheat flour with psyllium seeds powder on color attributes of biscuit.

Treatments*	Control	3% PSP	6% PSP	9% PSP
Parameters**				
L	70.870^{a}	70.660^{b}	70.230^{c}	70.090^{d}
A	04.100^{d}	04.950^{c}	05.870^{b}	07.200^{a}
B	14.120^{d}	15.870^{c}	17.080^{b}	18.420^{a}
A/B	00.290^{d}	00.312^{c}	00.344^{b}	00.391^{a}

*Control 100% WF, 3% PSP (97WF/3PSP), 6% PSP (94WF/6PSP) and 9% PSP (91WF/9PSP).

Table 6: Effect of substitution wheat flour with psyllium seeds powder on chemical composition and Energy value of biscuit.

Treatments*	Control	3% PSP	6% PSP	9% PSP
Parameters				
Moisture	004.56^{d}	004.82^{c}	004.84^{b}	004.88^{a}
Protein	006.92^{d}	007.54^{c}	007.62^{b}	007.70^{a}
Fat	015.27^{d}	015.38^{c}	015.41^{b}	015.52^{a}
Ash	001.91^{d}	002.15^{c}	002.21^{b}	002.28^{a}
Crude fiber	000.58^{d}	000.78^{c}	001.16^{b}	001.39^{a}
Carbohydrate	070.76^{a}	069.33^{b}	068.76^{c}	068.23^{d}
Energy(kcal/100g)	448.15^{a}	445.90^{b}	444.21^{c}	443.40^{d}

*Control 100% WF, 3% PSP (97WF/3PSP), 6% PSP (94WF/6PSP) and 9% PSP (91WF/9PSP).

Table 7: Effect of substitution wheat flour with psyllium seeds powder on physical traits of biscuit.

Treatments*	Control	3% PSP	6% PSP	9% PSP
Parameters:				
Diameter(D)	4.36[a]	4.22[a,b]	4.10[b]	4.06[b]
Thickness(T)	0.85[d]	0.92[c]	0.98[b]	1.01[a]
Spread ratio(D/T)	5.13[a]	4.59[b]	4.18[c]	4.02[c]

*Control 100% WF, 3% PSP (97WF/3PSP), 6% PSP (94WF/6PSP) and 9% PSP (91WF/9PSP).

Table 8: Effect of substitution wheat flour with psyllium seeds powder on sensory evaluation of biscuit.

Treatments*	Control	3% PSP	6% PSP	9% PSP
Parameters				
Appearance	8.86[a]	8.57[b]	7.71[c]	6.86[d]
Color	9.00[a]	8.29[b]	7.86[c]	7.86[c]
Texture	8.14[a]	8.29[a]	7.86[b]	7.29[c]
Oder	9.00[a]	8.14[b]	7.86[c]	7.71[d]
Taste	8.57[a]	8.00[b]	7.71[c]	7.43[d]
Over all acceptability	8.71[a]	8.26[b]	7.80[c]	7.43[d]

*Control 100% WF, 3% PSP (97WF/3PSP), 6% PSP (94WF/6PSP) and 9% PSP (91WF/9PSP).

تأثير استبدال دقيق القمح بمسحوق بذور السيليوم على صفات جودة البسكويت

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الملخص العربي

الهدف من هذا البحث تقييم تأثيراستبدال دقيق القمح بمسحوق بذورالسيلليوم عند مستويات0 و3 و6و9٪على الخواص الكيميائية والحسية للبسكويت المنتج والريولوجية للعجين.أدى استبدال دقيق القمح بمسحوق بذورالسيليوم إلى زيادة معنوية في محتوى الألياف الخام والرماد والبروتين والدهون من 0.58.1.91.6.92 و 15.27٪ على التوالي لبسكويت الكنترول إلى 1.39.28.7.7 و 15.52٪على التوالي لعينة البسكويت المنتجة من خلطة الدقيق التي تحتوي على9٪ مسحوق بذور السيلليوم ،بينما خفضت محتوى الكربوهيدرات لنفس العينات من 70.76٪ إلى 68.23٪. وأظهرت النتائج أن الاستبدال الجزئي لـدقيق القمح بمسحوق بذور السيليوم زاد من امتصاص الماء ووقت الوصول وزمن تطور العجين،بينما قلل من قابلية العجين للتمدد. كما أدى استبدال دقيق القمح إلى زيادة مرونة وطاقة العجين.وقد أوضحت النتائج زيادة محتوى البروتين من 6.92٪ لعينة المقارنة إلى 7.54 و 7.62 و7.70٪ للعينات المحتوية علي 3٪ مسحوق البذور و6٪ مسحوق البذور و9٪ مسحوق البذورعلى التوالي. ولوحظ نفس الاتجاه أيضًا مع محتوى الألياف الخام الذي زاد من 0.58٪ لعينة المقارنة إلى 0.78 و1.16 و1.39٪ للعينات المحتوية علي 3٪مسحوق البذور و6٪ مسحوق البذور و9٪ مسحوق البذورعلى التوالي.كما أدى استبدال دقيفق القمح بمسحوق بذورالسيلليوم إلى تقليل قطر البسكويت من 4.36 سم لعينة المقارنة إلى 4.22 و 4.10 و4.06 سم للعينات المحتوية علي 3٪ مسحوق البذور و6٪ مسحوق البذورو9٪ مسحوق البذور على التوالي.وقد أثراستبدال دقيفق القمح بمسحوق بذورالسيلليوم سلبًا على جميع الخصائص الحسية للبسكويت حيث انخفضت قيمها مع زيادة مستوى الاستبدال.وقد دلت النتائج أن عينة البسكويت المحضرة باستبدال دقيفق القمح بـ9٪مسحوق البذوركانت أقل قيم لجميع الخصائص الحسية ولكنها لا تزال مقبولة.

الكلمات الاسترشادية: بذور السيليوم, بسكويت, الخواص الريولوجيه.