



## ENGINEERING SCIENCES

# Effect of wheat bran and whole wheat flour on manti quality

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**Abstract:** Wheat bran and whole wheat flour are excellent dietary fibre (DF) sources which are widely used in food industry to produce high fibre food products. Although they are successfully utilized in several cereal based food formulations, there is no report regarding their use in manti which is a traditional Turkish food consumed all over the country. This study aimed to investigate the effects of wheat bran and whole wheat flour on the nutritional and cooking quality of manti. Samples were produced in an industrial plant and evaluated in terms of DF, phytic acid, *in vitro* glycemic index (GI), color and cooking quality (cooking loss, cooking time, weight increase). Although an increase was observed in phytic acid contents of manti produced from wheat bran or whole wheat flour, their DF contents increased without any adverse effect on cooking quality compared to control manti produced from refined flour. Besides, whole wheat flour resulted in a significant decrease in GI. The outcomes of this study demonstrates the applicability of wheat bran and whole wheat flour for industrial-scale production of manti with a good nutritional profile.

**Key words:** wheat bran, whole wheat flour, manti, dietary fibre, *in vitro* glycemic index.

## INTRODUCTION

Food products rich in fibre have gained attention in recent years due to their potential health benefits such as regulating the transit of food through the intestine, reducing the risk of type II diabetes, cardiovascular diseases, and cancer (especially colon cancer) (Macagnan et al. 2016). These potential health benefits have been reported to be related to dietary fibre (DF) intake. DF is a dietary component that is not enzymatically digested in the stomach and small intestine (Howarth et al. 2009). DF consumption is recommended by guidelines worldwide. The recommended daily intake of DF differs among the countries and varies between 25-45 g/day (EFSA 2011). However, DF consumption is generally lower than the recommended levels. Therefore, it gains importance to use fibre rich ingredients in food formulations to develop high

fibre products which would help consumers to meet such recommendations (Dhingra et al. 2012, Rasane et al. 2015, Singh et al. 2015).

Whole wheat grain and wheat bran are the major DF sources widely used in the food industry (Hemdane et al. 2016). Although the inclusion of wheat bran and whole wheat flour in food formulations is important in providing health-beneficial components, they may have negative impact on processing and may decrease product quality especially in cereal based foods (Cheng et al. 2021).

Manti is an important traditional cereal based food consumed in Turkey. It may be produced either unstuffed or stuffed with mashed potatoes, cheese, minced meat, and spices. Manti is preferred by consumers for its low cost, fast and easy preparation and cooking. Nowadays, manti gains popularity in

many European countries besides Turkey as its production is industrialized. Main ingredients of manti are refined wheat flour, salt, egg, and water. Unleavened wheat dough prepared by mixing the ingredients is rolled, sheeted, cut into a square shape, pinched the corners with special pinching methods which depends on the region of Turkey to form a little pouch, and then baked in the oven. Since it contains mainly starch, the nutritional properties of manti can be improved by DF sources.

In the view of current literature, DF sources were reported to be used to improve the nutritional quality of foods that are similar to manti, including noodles (Levent et al. 2020, Manaos et al. 2020, Tuncel et al. 2017), pasta (Aravind et al. 2012, Levent et al. 2020, Sobota et al. 2015) and spaghetti (Bagdi et al. 2014). However, there has been no report on the effect of fibre enrichment on nutritional properties and cooking quality of Turkish traditional food, manti. Since developing high fibre food products is important for increasing the DF consumption, the current study aimed to investigate the effect of wheat bran and whole wheat flour on the nutritional and functional properties of manti produced in an industrial plant. For this purpose, manti samples were evaluated in terms of dietary fibre and phytic acid contents, *in vitro* glycemic index value, color and cooking quality.

## MATERIALS AND METHODS

### Raw materials

White wheat flour (WF), wheat bran (WB, fine bran), and whole wheat flour (WWF) were commercial products obtained from Emek Un and İrmik San. Tic. A.Ş. (Ankara, Turkey), Field Crops Central Research Institute (Ankara, Turkey) and Hatap Un A.Ş. (Çorum, Turkey), respectively. Egg and salt used in the manti formulation were supplied from Çorum Yumurta A.Ş.

(Çorum, Turkey) and Çiçek Tuz (Ankara, Turkey), respectively.

### Chemical analyses

Moisture content of raw materials and manti samples were determined according to AACCI Method no: 44-01 (2010). Protein and ash contents of flour and manti samples were analysed according to AACCI Method no: 46-13.01 and 08-01.01, respectively (2010). Total dietary fibre (TDF), insoluble dietary fibre (IDF), soluble dietary fibre (SDF) contents of raw materials and manti samples were assessed using an enzymatic-gravimetric method (Method no: 32-07.01) with the fibre assay kit (Megazyme, Ireland) (AACCI 2010). Phytic acid (PA) was measured according to Vaintraub & Lapteva (1988). PA in the raw materials and manti samples was extracted at room temperature with a HCl solution (0.6 N) for 2 h. After centrifugation at 18,550 x g for 30 min (Sigma 3-18 K centrifuge, Göttingen, Germany), supernatant was separated, mixed with Wade reagent (0.03% solution of FeCl<sub>3</sub>·6H<sub>2</sub>O containing 0.3% sulfosalicylic acid), vortexed, and centrifuged again (6600 x g for 10 min, Sanyo MSE, UK). The absorbance was measured at a wavelength, λ=500 nm by GENESYS 10S UV-VIS spectrophotometer (Thermo Scientific, U.S.A.). PA concentration was calculated against a curve built by standard PA solutions with different concentrations varying between 0-58.7 µl/ml prepared from phytic acid sodium salt hydrate (P8810, Sigma). The results are expressed on a dry basis (db).

### Manti production

Manti, which is unique to Çorum and has no stuffing material, was produced at Kemal Öz Food Factory (Çorum, Turkey). Main ingredients in manti production were wheat flour (74%), salt (0.75%), egg (2.25%), and water (23%). Manti dough was prepared by mixing the ingredients.

Then, the dough was rolled, fed to the dough machine and manti shape was given. Manti shaped dough was baked (220 °C, 45 min) in an industrial conveyor oven and then cooled to 26 °C on a ventilation belt. This production line is used by the factory in commercial manti (WF manti) production for the market. For the production of WWF manti, WF was replaced by WWF. Water content of manti dough prepared from WWF was manually determined based on proper consistency. Bran supplemented manti was produced after determining the dietary fibre contents of WF and WB. To claim a food product as it is high in fibre, that product has to contain at least 6 g DF in 100 g according to European Commission Regulation (2006). The amount of bran required for the production of high fibre food was calculated on this basis. Manti samples were stored at 4 °C in plastic bags, and ground (IKA A10, Germany) to pass 500 µm mesh size (JEOTEST, Turkey) before analysis.

### Estimation of *in vitro* glycemic index value

In order to determine *in vitro* glycemic index (GI) values, method proposed by Englyst et al. (1992) for *in vitro* starch hydrolysis was followed. 100 mg manti sample was weighed into 50 ml tubes with 10 glass balls (5 mm diameter), and then HCl solution (2 ml, 0.05 M) and 10 mg of pepsin were added. After incubating the mixture in a shaking water bath (37 °C, 30 min), 4 ml sodium acetate buffer (0.5 M, pH 5.2) and 1 ml of freshly prepared enzyme solution (0.139 g pancreatin and 14.26 U amyloglucosidase) were added subsequently. During the incubation in a shaking water bath at 37 °C, aliquots (100 µL) were taken at subsequent times (0, 10, 20, 30, 60, 90, 120, and 180 min) and mixed with 1 ml ethanol (50%). After centrifugation at 800 x g for 10 min, glucose contents of supernatants were assessed using glucose oxidase-peroxidase assay kit (Megazyme Int., Ireland).

According to Goñi et al. (1997), the percentage of starch hydrolysed at time  $t$  (min) is described by  $C = C_{\infty}(1 - e^{-kt})$ , where  $C_{\infty}$  is the equilibrium percentage of starch hydrolysed after 180 min, and  $k$  is a kinetic constant which were assessed from starch digestion measurements. The area under the hydrolysis curve (AUC) was calculated using:  $AUC = C_{\infty}(t_f - t_0) - (C_{\infty}/k)[1 - \exp\{-k(t_f - t_0)\}]$ . Here,  $t_f$  and  $t_0$  are the final time (180 min) and initial time (0 min), respectively. Calculated AUC value was divided by AUC of a reference material (control, white bread) to determine hydrolysis index (HI) which represents the rate of starch digestion, then GI was predicted using the following relation:  $GI = 39.71 + 0.549 HI$  (Goñi et al. 1997).

### Color analyses

Uncooked manti samples were ground and their color were measured using Minolta CM-3600d spectrophotometer (Tokyo, Japan). The color values were expressed by lightness ( $L^*$ ), redness ( $a^*$ ), and yellowness ( $b^*$ ).

### Cooking quality

Cooking quality of manti samples was determined as cooking time, weight increase and solids lost to cooking water according to AACCI Method no: 66-50 (2010). 25 g of manti sample were cooked in 250 ml boiling tap water. Cooking time was determined by following the disappearance of the white core at the centre of the compressed sample between two glass pieces. Weight increase was calculated by dividing the cooked manti weight to its initial weight (25 g). Cooking loss was determined from the weight of solid content in the cooking water and expressed in percentages.

### Statistical analysis

Data were analysed with SPSS software (IBM SPSS Statistics, version 22) using one-way analysis

of variance (ANOVA). Significance among the means was defined  $p < 0.05$  by Duncan test. At least two replications were made for analysis of each sample.

## RESULTS AND DISCUSSION

### Chemical properties of manti flours

Chemical compositions of raw materials are presented in Table I. Ash contents of WF, WB and WWF were found as 0.65, 4.41 and 1.42%, respectively. Protein contents of the samples varied between 13.8 and 20.2%. WF had the lowest protein content. WWF had significantly higher protein content (17.3%) than WF ( $p < 0.05$ ). The highest ash and protein contents were found in WB among other samples, which is in line with the literature (Kumar et al. 2011, Schmiele et al. 2012). For a good quality noodle production, the flour requires to have a medium protein content (10-12%), however, for whole wheat noodle, flour with higher protein is more suitable as the gluten network was disrupted by bran particles (Niu & Hou 2019). Therefore, WB and WWF used in this study were found to be suitable for manti production. TDF, IDF and SDF contents of WF were 4.58, 2.84 and 1.74%, respectively (Table I). While WF had the lowest fibre composition, bran had the highest as expected, since the bran layers are rich in DF (Rosa-Sibakov et al. 2015). WB had a DF composition within the ranges reported in the literature as 36.5-52.4, 35.0-48.4 and 1.5-4.0%, respectively, for TDF, IDF and SDF (Chinma et al.

2015, Vitaglione et al. 2008). WWF had significantly higher TDF, IDF and SDF contents than WF (Table I). WWF is prepared from wheat such that the fractions of the grain (such as bran) remain unaltered (Doblado-Maldonado et al. 2012), hence resulting in increasing nutritional value of the product. Consequently, higher TDF, IDF and SDF contents of WWF than those of WF found in the present study are in accordance with the literature (Prasadi & Joye 2020, Schmiele et al. 2012, Seyer & Gelinas 2009).

Phytic acid (PA) contents of WF, WB and WWF were 2.48, 35.36 and 9.54%, respectively (Table I). Significant differences were observed in PA contents of raw materials. As the main portion of PA is found in the bran layers of wheat grain (Reddy 2002), the products such as WWF could have higher PA levels than refined one (García-Estapa et al. 1999). This is also supported by a higher ash content of WWF when compared to that of WF, as the bran composition is rich in minerals such as phosphorous (Schmiele et al. 2012).

### Chemical properties of manti samples

According to the TDF results presented above, WB manti was produced from bran-flour blend prepared by mixing 15% wheat bran with 85% white wheat flour.

Manti samples had ash and protein contents varying between 2.40-3.07 and 11.3-16.3%, respectively (Table II). While the highest ash content was observed in the WB manti, the

**Table I. Chemical composition of raw materials.**

Sample name	Moisture (%)	Ash (% db)	Protein (% db)	TDF (%db)	IDF (%db)	SDF (%db)	PA (mg/g db)
White wheat flour	12.7±0.05a	0.65±0.009c	13.8±0.45c	4.58±0.242c	2.84±0.019c	1.74±0.223b	2.48±0.417c
Wheat bran	9.5±0.02b	4.41±0.006a	20.2±0.06a	41.00±0.068a	37.09±0.391a	3.90±0.459a	35.36±0.280a
Whole wheat flour	12.6±0.19a	1.42±0.013b	17.3±0.68b	12.48±0.157b	8.77±0.564b	3.71±0.407a	9.54±0.595b

TDF: total dietary fibre, IDF: insoluble dietary fibre, SDF: soluble dietary fibre, PA: phytic acid, db: dry basis  
a-c Values in the same column with different letters differ significantly ( $p < 0.05$ ).

highest protein content was found in WWF manti. Supplementation of bran and replacement of WF with WWF significantly increased protein contents of manti samples ( $p < 0.05$ ). High fibre ingredients like wheat bran and whole wheat flour are low in gluten but rich in ash and proteins. Therefore, an increase in bran fraction or replacement of wheat flour with whole wheat flour in formula would result in an increase in total protein content. Similar findings were also observed by Bilgiçli et al. (2006) for WB incorporated tarhana samples. On the other hand, Manaois et al. (2020) reported a significant increase in ash content of noodle samples with the incorporation of bran, while the protein content remained unchanged.

Dietary fibre contents of manti samples were presented in Table II. TDF, IDF and SDF contents of manti sample produced from WF were 4.96, 3.56 and 1.40%, respectively. Supplementation of bran and replacement of WF with WWF significantly increased TDF contents of manti samples to 11.23 and 11.03%, respectively ( $p < 0.05$ ). There were also significant increases in IDF and SDF contents of WB and WWF manti samples when compared to that of WF manti. Bagdi et al. (2014) reported significant increases in TDF, IDF and SDF contents of spaghetti sample produced by using aleurone-rich flour when compared to those of control sample which was produced from wheat pasta flour. It was also reported by Levent et al. (2020), Tuncel et al. (2017) and Manaois et al. (2020) that the addition

of different cereal brans increased TDF content of pasta and noodle samples.

Phytic acid (PA) content of manti samples varied between 4.89 and 10.66 mg/g (Table II), where the highest value was observed in WWF manti. Since the most of the PA in cereals is concentrated in the outer layers of the grain, relatively higher ash contents resulted in higher PA contents for manti samples produced from bran supplemented flour and WWF (Reddy 2002). This is in accordance with the literature that the increase in bran content of noodles increased PA content as expected (Tuncel et al. 2017).

*In vitro* glycemic index (GI) values of manti samples varied between 87.3 and 90.5 (Table II). While the bran supplementation did not have a significant impact on lowering the GI value of manti sample, WWF decreased the estimated GI significantly ( $p < 0.05$ ). A similar decrease in predicted GI values was also observed for cake and noodle samples produced after the replacement of white flour with WWF by Bae et al. (2013; 2016). Although the TDF contents of WB and WWF manti samples were similar, a small but significant difference observed in GI value could be due to a higher SDF content of WWF manti. Besides, it was reported that the bran supplementation up to a certain level did not significantly affect *in vitro* starch hydrolysis index, thus, *in vitro* GI of biscuit samples (Sozer et al. 2014). Although the manti samples produced in the current study are in the high GI group according to *in vitro* analysis (EFSA

**Table II. Chemical composition and *in vitro* (estimated) glycemic index values of manti samples.**

Sample name	Ash (% db)	Protein (% db)	TDF (%db)	IDF (%db)	SDF (%db)	PA (mg/g db)	GI
White wheat flour manti	2.40±0.012c	11.3±0.06c	4.96±0.325b	3.56±0.059c	1.40±0.266c	4.89±0.108c	90.5±0.07a
Bran supplemented manti	3.07±0.013a	13.2±0.11b	11.23±0.067a	8.58±0.031a	2.65±0.036b	9.32±0.172b	89.3±0.93a
Whole wheat flour manti	2.61±0.013b	16.3±0.23a	11.03±0.074a	7.22±0.369b	3.81±0.295a	10.66±0.232a	87.3±0.02b

TDF: total dietary fibre, IDF: insoluble dietary fibre, SDF: soluble dietary fibre, PA: phytic acid, GI: glycemic index, db: dry basis  
a-c Values in the same column with different letters differ significantly ( $p < 0.05$ ).

2010), lower GI values can be obtained in *in vivo* studies (Ferrer-Mairal et al. 2012).

### Color characteristics and cooking quality

Color of manti samples are expressed as L\*, a\* and b\* values (Table III). The L\* values of manti samples produced from bran supplemented flour and WWF decreased from 89.16 to 80.65 and 80.75, respectively, indicating a significant increase in darkness. Lowest L\* value can be explained by a higher ash and DF content (Ugarčić-Hardi et al. 2007). On the contrary, a\* values of the corresponding samples increased significantly ( $p < 0.05$ ) when compared to the manti sample produced from WF, indicating an increase in redness. WB manti had the highest b\* value, while the lowest b\* value was observed in WWF manti sample. High b\* value is desirable for pasta color (Ugarčić-Hardi et al. 2007). The differences in b\* values were found significant between the manti samples ( $p < 0.05$ ). It is also reported by Wang et al. (2018) and Kaur et al. (2012) that the increasing amount of DF resulted in a decrease in lightness and an increase in redness of noodle and pasta samples.

Visual appearance of uncooked and cooked manti samples are presented in Figure 1. It can be observed that WF manti had the lightest color, while the bran supplementation and WWF resulted in a browner color which is also

supported by color values of uncooked manti samples presented in Table III.

Cooking quality of manti samples was determined as cooking time, weight increase and solids lost to the cooking water. While the optimum cooking time was reported to be less for pasta that contains cereal bran (Kaur et al. 2012), in the current study, optimum cooking time (11:30 min) was found to be the same for all manti samples. In other words, bran supplementation or WWF did not affect the optimum cooking time. The same observation was also made by Aravind et al. (2012) up to a certain level of bran addition to spaghetti. Weight increases of manti samples were within the range of 176-215% (Table III). The highest weight increase was observed in WF manti sample. This could be due to a uniform distribution of particles in WF that promotes a well-developed protein-starch matrix leading to high quality pasta that retains more water (Vignola et al. 2018). Bran supplementation and WWF resulted in a significant decrease in the weight increase of manti samples ( $p < 0.05$ ). A decrease was also reported by Aravind et al. (2012) in the weight increase of pasta samples with increasing bran content. However, Sobota et al. (2015) reported no significant difference between the weight increase index of the pasta samples produced from white flour, bran supplemented flour and WWF. On the contrary, Ertaş (2014) reported an

**Table III. Color characteristics and cooking properties of manti samples.**

Sample name	Color values			$\Delta E$	Cooking quality	
	L*	a*	b*		Cooking loss (%)	Weight increase (%)
White wheat flour manti	89.16a	0.43b	16.17b	-	8.88a	215a
Bran supplemented manti	80.65b	3.51a	17.10a	9.10	7.21b	181b
Whole wheat flour manti	80.75b	3.47a	14.78c	9.05	7.29b	176b

L\*: lightness, a\*: redness, b\*: yellowness,  $\Delta E$ : color difference.

a-c Values in the same column with different letters differ significantly ( $p < 0.05$ ).

increase in the weight of cooked erişte with rice bran substitution. Cooking loss is an indicator of the integrity and compactness in pasta and noodles (Niu & Hou 2019) which affects consumer acceptance and product quality (Demi et al. 2010; Tuncel et al. 2017). Cooking loss of manti samples varied between 7.21 and 8.88%. The highest cooking loss was observed in WF manti, while WB and WWF manti samples had similar cooking losses (Table III). Supplementation of bran and WWF decreased cooking loss of manti samples significantly ( $p < 0.05$ ). Lee et al. (1998) reported a decrease in cooking loss of noodles after supplementation of garbanzo bean flour which had a high fibre content. It was also reported by Ugarčić-Hardi et al. (2007) that the supplementation of wheat straw significantly decreased cooking loss of pasta sample when compared to that of produced from common wheat flour. However, contrary results are also reported in the literature. Aravind et al. (2012)

reported an increase in cooking loss in spaghetti samples with increasing bran supplementation levels. It was also reported by Aydin & Gocmen (2011) that the oat flour addition resulted in a significant increase in cooking loss of erişte (noodle). In general, the increase in fibre rich ingredients results in an increase in dry matter losses during cooking (Sobota et al. 2015) which is attributed to the gluten network deterioration (Vignola et al. 2018). Nevertheless, the high protein contents of WB and WWF used in the current study and the presence of egg in the manti formulation may have resulted in a reduced cooking loss.

## CONCLUSION

In this study, the effect of wheat bran and whole wheat flour on nutritional and cooking quality of manti was evaluated. For this purpose, chemical composition, color and cooking properties



**Figure 1.** Visual appearance of manti samples before and after cooking. a, c, e : raw samples of white wheat flour manti, bran supplemented manti and whole wheat flour manti, respectively, b, d, f : cooked samples of white wheat flour manti, bran supplemented manti and whole wheat flour manti, respectively.

of wheat bran and whole wheat flour manti samples were determined and compared to those of the commercial manti produced from refined wheat flour under identical conditions. Results showed that the fibre contents of wheat bran and whole wheat flour manti samples were higher than 6 g for 100 g product, thus each sample can be referred to as a high fibre product according to European Commission Regulation. Moreover, bran and whole wheat flour resulted in a lower cooking loss which is desirable both for manufactures and consumers. Although the PA contents of WB and WWF manti samples were higher than that of control, it can be reduced by several pre-treatments applied on wheat bran and whole wheat flour. Besides, significantly low but still high GI of the manti samples can be reduced by using soluble fiber-rich ingredients in the formulation. To conclude, this study demonstrated the applicability of the use of high fibre materials such as wheat bran and whole wheat flour on an industrial scale production of manti to promote high fibre food consumption and increase dietary fibre intake.

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### REFERENCES

AACC INTERNATIONAL. 2010. Approved Methods of Analysis, AACC International, St. Paul, MN.

ARAVIND N, SISSONS M, EGAN N & FELLOWS C. 2012. Effect of insoluble dietary fibre addition on technological, sensory, and structural properties of durum wheat spaghetti. *Food Chem* 130: 299-309. DOI: 10.1016/j.foodchem.2011.07.042.

AYDIN E & GOCMEN D. 2011. Cooking quality and sensorial properties of noodle supplemented with oat flour. *Food Sci Biotechnol* 20: 507-511. DOI: 10.1007/s10068-011-0070-1.

BAE IY, KIM HJ, INGLETT GE & LEE S. 2016. Effect of whole grain wheat flour on the mixing properties, oil uptake, and in vitro starch digestibility of instant fried noodles. *Cereal Chem* 93: 100-103. DOI: 10.1094/CCHEM-04-15-0063-N.

BAE IY, LEE HI, KO A & LEE HG. 2013. Substituting whole grain flour for wheat flour: Impact on cake quality and glycemic index. *Food Sci Biotechnol* 22: 1-7. DOI: 10.1007/s10068-013-0216-4.

BAGDI A, SZABO F, GERE A, KOKAI Z, SIPOS L & TÖMÖSKÖZI S. 2014. Effect of aleurone-rich flour on composition, cooking, textural, and sensory properties of pasta. *Food Sci Technol* 59: 996-1002. DOI: 10.1016/j.lwt.2014.07.001.

BILGIÇLI N, ELGÜN A, HERKEN EN, TÜRKER S, ERTAŞ N & İBANOĞLU Ş. 2006. Effect of wheat germ/bran addition on the chemical, nutritional and sensory quality of tarhana, a fermented wheat flour-yoghurt product. *J Food Eng* 77: 680-686. DOI: 10.1016/j.jfoodeng.2005.07.030.

CHENG W, SUN Y, FAN M, LI Y, WANG L & QIAN H. 2021. Wheat bran, as the resource of dietary fiber: a review. *Crit Rev Food Sci Nutr* 2021: 1-28. DOI: 10.1080/10408398.2021.1913399.

CHINMA CE, RAMAKRISHNAN Y, ILOWEFAH M, HANIS-SYAZWANI M & MUHAMMAD K. 2015. Properties of cereal brans: A review. *Cereal Chem* 92: 1-7. DOI: 10.1094/CCHEM-10-13-0221-RW.

DEMI B, BILGIÇ N, ELDÜN A & DEMI MK. 2010. Effects of chickpea flours and whole egg on selected properties of erite, turkish noodle. *Food Sci Technol Res* 16: 557-564. DOI: 10.3136/fstr.16.557.

DHINGRA D, MICHAEL M, RAJPUT H & PATIL RT. 2012. Dietary fibre in foods: A review. *J Food Sci Technol* 49: 255-266. DOI: 10.1007/s13197-011-0365-5.

DOBLADO-MALDONADO AF, PIKE OA, SWELEY JC & ROSE DJ. 2012. Key issues and challenges in whole wheat flour milling and storage. *J Cereal Sci* 56: 119-126. DOI: 10.1016/j.jcs.2012.02.015.

ENGLYST HN, KINGMAN SM & CUMMINGS JH. 1992. Classification and measurement of nutritionally important starch fractions. *Eur J Clin Nutr* 46: S33-S50.

ERTAŞ N. 2014. Reutilisation of rice byproduct: study on the effect of rice bran addition on physical, chemical and sensory properties of erişte. *Qual Assur Saf Crop* 6: 249-255. DOI: 10.3920/QAS2013.0252.

EUROPEAN COMMISSION REGULATION. 2006. Regulation (EC) No 1924/2006 of the European Parliament and of the Council of 20 December 2006 on nutrition and health claims made on foods. *Official Journal of the European Union* L404: 9-25.



- EFSA - EUROPEAN FOOD SAFETY AUTHORITY. 2010. Scientific Opinion on Dietary Reference Values for carbohydrates and dietary fibre. *EFSA Journal* 8: 1-77.
- EFSA - EUROPEAN FOOD SAFETY AUTHORITY. 2011. Scientific Opinion on the substantiation of health claims related to arabinoxylan produced from wheat endosperm and reduction of post-prandial glycaemic responses (ID 830) pursuant to Article 13(1) of Regulation (EC) No 1924/2006. *EFSA Journal* 9: 2205.
- FERRER-MAIRAL A, PEÑALVA-LAPUENTE C, IGLESIA I, URTASUN L, DE MIGUEL-ETAYO P, REMÓN S, CORTÉS E & MORENO LA. 2012. In vitro and in vivo assessment of the glycemic index of bakery products: influence of the reformulation of ingredients. *Eur J Nutr* 51: 947-954. DOI: 10.1007/s00394-011-0272-6.
- GARCÍA-ESTEPA RM, GUERRA-HERNÁNDEZ E & GARCÍA-VILLANOVA B. 1999. Phytic acid content in milled cereal products and breads. *Food Res Int* 32: 217-221. DOI: 10.1016/S0963-9969(99)00092-7.
- GOÑI I, GARCIA-ALONSO A & SAURA-CALIXTO F. 1997. A starch hydrolysis procedure to estimate glycemic index. *Nutr Res* 17: 427-437.
- HEMDANE S, JACOBS PJ, DORNEZ E, VERSPREET J, DELCOUR JA & COURTIN CM. 2016. Wheat (*Triticum aestivum* L.) Bran in Bread Making: A Critical Review. *Compr Rev Food Sci Food Saf* 15: 28-42. DOI: 10.1111/1541-4337.12176.
- HOWARTH NC, SALTZMAN E & ROBERTS SB. 2009. Dietary Fiber and Weight Regulation. *Nutr Rev* 59: 129-139. DOI: 10.1111/j.1753-4887.2001.tb07001.x.
- KAUR G, SHARMA S, NAGI HPS & DAR BN. 2012. Functional properties of pasta enriched with variable cereal brans. *J Food Sci Technol* 49: 467-474. DOI: 10.1007/s13197-011-0294-3.
- KUMAR P, YADAVA R, GOLLEN B, KUMAR S, VERMA R & YADAV S. 2011. Nutritional Contents and Medicinal Properties of Wheat: A Review. *Life Sciences and Medicine Research* 2011: 1-10.
- LEE L, BAIK BK & CZUCHAJOWSKA Z. 1998. Garbanzo bean flour usage in cantonese noodles. *J Food Sci* 63: 552-558. DOI: 10.1111/j.1365-2621.1998.tb15784.x.
- LEVENT H, KOYUNCU M, BILGIÇLI N, ADIGÜZEL E & DEDEOĞLU M. 2020. Improvement of chemical properties of noodle and pasta using dephytinized cereal brans. *LWT* 128: 109470. DOI: 10.1016/j.lwt.2020.109470.
- MACAGNAN FT, DA SILVA LP & HECKTHEUER LH. 2016. Dietary fibre: The scientific search for an ideal definition and methodology of analysis, and its physiological importance as a carrier of bioactive compounds. *Food Res Int* 85: 144-154. DOI: 10.1016/j.foodres.2016.04.032.
- MANAOIS RV, ZAPATER JEI & LABARGAN ESA. 2020. Nutritional qualities, antioxidant properties and sensory acceptability of fresh wheat noodles formulated with rice bran. *Int Food Res* 27: 308-315.
- NIU M & HOU GG. 2019. Whole wheat noodle: Processing, quality improvement, and nutritional and health benefits. *Cereal Chem* 96: 23-33. DOI: 10.1002/cche.10095.
- PRASADI NPV & JOYE IJ. 2020. Dietary Fibre from Whole Grains and Their Benefits on Metabolic Health. *Nutrients* 12: 3045. DOI: 10.3390/nu12103045.
- RASANE P, JHA A, SABIKHI L, KUMAR A & UNNIKISHNAN VS. 2015. Nutritional advantages of oats and opportunities for its processing as value added foods - a review. *J Food Sci Technol* 52: 662-675. DOI: 10.1007/s13197-013-1072-1.
- REDDY NR. 2002. Occurrence, Distribution, Content, and Dietary Intake Phytate. In: REDDY NR & SATHE SK (Eds), *Food Phytates*, Boca Raton, Florida: CRC Press ISBN: 1566768675.
- ROSA-SIBAKOV N, POUTANEN K & MICARD V. 2015. How does wheat grain, bran and aleurone structure impact their nutritional and technological properties? *Trends in Food Sci Technol* 41: 118-134. DOI: 10.1016/j.tifs.2014.10.003.
- SCHMIELE M, JAEKEL LZ, PATRICIO SMC, STEEL CJ & CHANG YK. 2012. Rheological properties of wheat flour and quality characteristics of pan bread as modified by partial additions of wheat bran or whole grain wheat flour. *Int J Food Sci Technol* 47: 2141-2150. DOI: 10.1111/j.1365-2621.2012.03081.x.
- SEYER ME & GELINAS P. 2009. Bran characteristics and wheat performance in whole wheat bread. *Int J Food Sci Technol* 44: 688-693. DOI: 10.1111/j.1365-2621.2008.01819.x.
- SINGH P, SINGH R, JHA A, RASANE P & KUMAR GAUTAM A. 2015. Optimization of a process for high fibre and high protein biscuit. *J Food Sci Technol* 52: 1394-1403. DOI: 10.1007/s13197-013-1139-z.
- SOBOTA A, RZEDZICKI Z, ZARZYCKI P & KUZAWIŃSKA E. 2015. Application of common wheat bran for the industrial production of high-fibre pasta. *Int J Food Sci Technol* 50: 111-119. DOI: 10.1111/ijfs.12641.
- SOZER N, CICERELLI L, HEINIÖ RL & POUTANEN K. 2014. Effect of wheat bran addition on in vitro starch digestibility, physico-mechanical and sensory properties of biscuits. *J Cereal Sci* 60: 105-113. DOI: 10.1016/j.jcs.2014.01.022.
- TUNCCEL NY, KAYA E & KARAMAN M. 2017. Rice Bran Substituted Turkish Noodles (Erişte): Textural, Sensorial, and

Nutritional Properties. *Cereal Chem* 95: 903-908. DOI: 10.1094/CCHEM-12-16-0289-R.

UGARČIĆ-HARDI Ž, JUKIĆ M, KOMLENIĆ DK, SABO M & HARDI J. 2007. Quality parameters of noodles made with various supplements. *Czech J Food Sci* 25: 151-157. DOI: 10.17221/742-cjfs.

VAINTRAUB IA & LAPTEVA NA. 1988. Colorimetric determination of phytate in unpurified extracts of seeds and the products of their processing. *Anal Biochem* 175: 227-230.

VIGNOLA MB, BUSTOS MC & PÉREZ GT. 2018. Comparison of quality attributes of refined and whole wheat extruded pasta. *LWT* 89: 329-335. DOI: 10.1016/j.lwt.2017.10.062.

VITAGLIONE P, NAPOLITANO A & FOGLIANO V. 2008. Cereal dietary fibre: a natural functional ingredient to deliver phenolic compounds into the gut. *Trends Food Sci Technol* 19: 451-463. DOI: 10.1016/j.tifs.2008.02.005.

WANG CC, MA S, LI L, ZHENG XL & WANG XX. 2018. Effect of modified dietary fibre from wheat bran on the quality of noodle. *Qual Assur Saf Crop* 10: 61-68. DOI: 10.3920/QAS2017.1076.

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