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Effect of Corn Bran Addition on Technological Properties of *Tagliarini* Pasta

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Abstract The objective of this study was to evaluate the partial substitution of wheat flour by heat-treated corn bran at the following levels (0, 5, 10, 15, 25 and 30%). Thermally treated corn bran (TTCB) presented 8.94% of moisture, 2.22% of ashes, 9.73% of proteins, 9.37% of lipid and 33.80% total dietary fiber. In addition, 73.21% of TTCB exhibited granulometry < 250 µm and 14 weeks of shelf-life. TTCB altered dough rheological properties, decreasing stability and dough development time, while increasing mixture tolerance index. Moreover, TTCB did not significantly alter the extension strength, leading to a diminishment in extensibility and an increase of dough curve configuration ratio, which characterizes a flour considerably resistant to extension, a desirable factor for tagliarini elaboration. Pasta quality test staged that TTCB incorporation in up to 14.53% has increased cooking period and volume, decreasing solids' loss. In addition, TTCB enhanced dough firmness and adhesiveness, reducing hardness and shear work.

Keywords: *corn bran, shelf-life, rheological analysis, tagliarini pasta, dough quality*

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1. Introduction

The consumption of food products incorporated with ingredients containing desirable functional properties has been intensifying in recent years [1]. In this context, the replacement of wheat flour with substitute flours offers the consumer differentiated products from the technological and nutritional perspective [2]. For instance, [3] assessed the effect of chia incorporation on physicochemical traits, cooking quality and sensorial properties in gluten-free pasta. Several other studies were carried out aiming food improvement, e.g. [1] assessed the effect of powdered grape pomace on cooking quality and sensorial properties of *fettuccini* pasta; [4] investigated the effect of soy protein isolated on functional properties and consumer acceptance of rice spaghetti. In addition, [5] also studied innovative flour combinations when studying the effect of *Psyllium* fiber content on rheological and texture characteristics of biscuit.

Corn (*Zea mays* L.) is a widely cultivated cereal worldwide, being the third most important crop after rice and wheat [6]. Corn world production presented an estimation of 984 million tons between 2015 and 2016. Regarding 2017 and January of 2018, the production increased to 1040-1054 million tons [7]. In industrial corn processing, a large quantity of solid residues is produced, being mainly utilized for animal feed. Nonetheless, corn bran presents considerable nutritional value, such as essential amino acids, protective phytochemicals, minerals, lipids, phenolic acids and dietary fibers. Thus, this product has been receiving great attention from specialists of food science due to its feasible incorporation into various food products [8,9,10,11], as in the works of [8,9,11,12,13].

Among the nutritional compounds present in corn bran, dietary fibers can be highlighted since the demand for healthy, tasty and high-fiber food products is increasing. Moreover, the deficiency in fiber intake is associated with the development of several diseases of intestine as well as colon cancer, constipation among others [11].

An effective manner to enhance food nutritional properties is the incorporation of functional ingredients [1]. Pasta is a product consumed worldwide for all social classes, therefore, this product enrichment with ingredients that contribute to its nutritional value improvement, such as amino acids, vitamins, minerals and fibers is wide-reaching interesting [14,15].

Pastas, when incorporated with non-traditional ingredients, may preset different technological behaviors than expected. According to [16], dietary fiber inclusion into the pasta can negatively alter the product's tenacity due to an alteration of protein integrity in gluten network. Consequently, this incorporation modified water absorption, cooking period, baking and texture loss. Therefore, quality tests in pasta are important indicators for determining the percentage of acceptable incorporation to achieve nutritional and technological balance [17].

In this context, pasta can be considered an interesting vehicle of dietary fiber incorporation. Thus, the objective of this study was to verify corn bran stability during storage period and assess the effect of corn bran incorporation in different levels (0, 5, 10, 15, 20, 25 and 30%) for rheological and physicochemical properties of wheat flour as well as for these properties in final *tagliarini* pasta produced by this mixture.

2. Material and Methods

2.1. Materials

Corn bran was donated by a local mill (Brazil) and the other ingredients were purchased in the market. The utilized reagents were acquired from Quimis brand. For alimentary fibers determination, a Sigma Determination Kit was utilized.

2.2. Production of Thermally Treated Corn Bran (TTCB)

The obtained corn bran was ground in TE 651 - TECNAL knife mill with 20 mesh sieve opening. Then, this bran was autoclaved at 121°C and 1.0 kg/cm^2 during 20 minutes in accordance with [18]. After cooling, TTCB exhibited moisture of 8.94% and was packed in a polyethylene bag at room temperature until further analyzes.

2.3. Granulometric Classification of TTCB

TTCB granulometric distribution was determined according to the 66-20 method of AACC [19].

2.4. Physicochemical Analyzes of TTCB

To determine ashes of TTCB, the method 01-08 was used, for lipids the technique 30-25 and for protein content the method 46-10, all according to [19]. The levels of soluble dietary fiber, insoluble dietary fiber and total dietary fiber were established by the enzymatic-gravimetric method in accordance with AOAC method 960-52 [20].

The pH was measured at 25°C using a potentiometer (Gehaka, PG 1800, Brazil) equipped with a combination of glass electrode and temperature probe [21]. Moisture content was determined in infrared balance (BEL engineering, Italy). In addition, water activity was accomplished in an Aqualab Decagon 3TE equipment, while carbohydrate content was achieved by the difference of other constituents as stated by [22].

2.5. Color Analysis of TTCB

Color attributes were performed before and after the thermal treatment utilizing a colorimeter Color Quest XE (Hunter Lab, USA). Color values were expressed as L^*, a^* and b*. The calorimetric difference (ΔE*) was calculated by the following equation [18].

$$\Delta E^* = \sqrt{(\Delta L^2 + \Delta a^2 + \Delta b^2)} \tag{1}$$

2.6. Shelf-life Determination

In order to determine shelf-life, an evaluation of the following variable was carried out: the content of free fatty acids during the storage period (0, 2, 4, 6, 8, 10, 12, 14, 16 and 24 weeks), the microbiological development and the mycotoxins presence at 0, 30, 60, 90 and 105 days for both corn bran without heat treatment (CB) and thermally treated corn bran (TTCB).

2.6.1. Analysis of free fatty acids (FFA)

Initially, the oil was extracted for CB and TTCB according to [18]. methodology. FFA content was measured along with [22] and calculated as the equivalent of oleic acid.

2.6.2. Microbiological analyzes

CB and TTCB samples were assessed in periods of 0, 30, 60, 90, 105 days for *Bacillus cereus, Salmonella* sp and coliforms at 45°C. Coliforms analysis at 45°C was performed by the most probable number method and *Bacillus cereus* assessment was carried out by plate count in accordance with [23]. Finally, *Salmonella* sp. examination was performed by BAM/FDA method in agreement with [24].

2.6.3. Mycotoxicological analyzes

Aflatoxin, fumonisin and zearalenone determination were accomplished with CB and TTCB. These were carried out after 105 storage days at room temperature using QuickTox Kit for QuickScan Fumonisin Scan (AQ-111 BG, EnviroLogix, USA) according to manufacturer's methodology.

2.7. Rheological properties of mixtures

Different levels of TTCB (5, 10, 15, 20, 25 e 30%) in addition to the control (0%) were incorporated into the wheat flour. Then, samples pharmacological properties were evaluated in Brabender Farinograph according to the method 54-21 [19]. Water absorption, dough development time (DDT), dough stability and mixing tolerance index (MTI) were the established parameters. Samples' elastic properties were determined in Texture Analyser (Stable Micro Systems, TA.XT plus, UK) equipped with a 50 kg load cell and a A/KIE accessory as described in the DOUI/KIE method with the aid of the Exponent Stable Micro Systems software. Test parameters were: pre-test velocity = 2.0 mm, test velocity = 3.30 mm, post-test velocity = 10 mm, distance = 75 mm and trigger force = 25 g [14]. The studied parameters were extension strength (*R*), extensibility (E), energy (EN) and curve proportionality (R/E). Samples viscoelastic behavior was achieved by alveograph test using a Chopin alveograph as stated by the [25] methodology. The evaluated parameters were dough tenacity (*W*), dough extension strength (*P*), dough extensibility (*L*) and dough curve configuration ratio (*P/L*).

2.8. Incorporation of TTCB into dry tagliarini pasta

2.8.1. Pasta elaboration

Pastas were prepared with different levels of corn bran (5, 10, 15, 20, 15 and 30%) in addition to the standard formulation (0%). The other ingredients were salt, oil and water in concentrations of 0.5, 2 and 32%, respectively. This pasta was extruded and cut into an *tagliarini* pasta with an Indian extruder series 372707. The drying process was carried out at 70ºC in a vertical dryer containing air circulation with mean velocity of 3m/s according to [26] with modifications.

2.8.2. Moisture and water activity of pasta

Moisture content was determined in infrared balance (BEL engineering, Italy), while water activity (Aw) was established on Aqualab Decagon 3TE equipment.

2.8.3. Cooking tests

Cooking tests were carried out aiming to estimate pasta quality. The optimal cooking time were assessed according to AACC 66-50 [19] with modifications. Water absorption, increase of volume and cooking loss were determined along with [27].

2.6. Texture assay of pasta

Texture assay was performed using a Texture Analyser (Stable Micro Systems, TA.XT plus, UK), where for the analysis of hardness and adhesiveness, a cylindrical probe P36 with the following parameters was utilized: pre-test velocity, test and post-test of 2mm/s, 60% of compression. For the analysis of firmness and shear force, a knife blade probe was used. The parameters utilized were: test speed of 0.17 mm/s, 10 mm/s post-test speed and 4.5 mm of distance. Both methodologies were established according to [14] methodology with slight modifications.

2.7. Experimental design

The experiment was conducted in a completely randomized design with three repetitions. Data of centesimal analyzes, granulometry, shelf-life and color were treated and estimated by means and standard deviations. Other data were submitted to analysis of variance (ANOVA) followed by regression analysis at 5% probability. The analyzes were carried out using the SAS (Statistical Analysis System) program version 9.1.

3. Results and Discussion

3.1. Granulometric classification

Granulometry outcomes denoted that 73.21% of TTCB particles were < 250 µm. According to [11], particles size exerts a significative and inversely proportional effect on hydration capacity.

3.2. Physicochemical properties

Corn bran is rich in total dietary fibers and has an elevated protein content, which contributes to nutritional quality improvement of pasta as can be observed in Table 1. According to [28], high-fiber foods are those that have concentration superior to 6g/100g of dietary fiber. Consequently, it is possible to affirm that TTCB is a product rich in fibers. Therefore, this treated corn bran presented promising use in pasta, which can improve nutritional quality.

Table 1. Physicochemical characteristics of thermally treated corn bran (TTCB) with the centesimal composition

Parameters	TTCB	Reference [9]	Reference [12]
Moisture (%)	8.94 ± 0.20	-	-
Ashes (%)	2.22 ± 0.06	3.54 ± 0.04	-
Proteins (%)	9.73 ± 0.35	12.02 ± 0.39	-
Carbohydrates (%)	33.64	-	-
Total fats (%)	9.37 ± 0.56	17.74 ± 0.33	-
Total Dietary Fibers (%)	33.80 ± 2.08	28.90 ± 1.90	30
Insoluble fiber (%)	27.30 ± 0.55	23.70 ± 1.10	-
Soluble fiber (%)	6.50 ± 0.14	3.54 ± 0.04	-
Water activity	0.53 ± 0.01	-	-
pH	6.98 ± 0.04	-	-
Acidity	5.75 ± 0.13	-	-

3.3. Color attributes

Color values (*L**, *a** and *b**) of TTCB and CB are shown in Table 2. Every color values (*L**, *a** and *b**) were affected by thermal treatment application.

Corn bran luminosity (L*) decreased after treatment. In addition, redness *(a**) has increased, while yellowing *(b*)* has diminished. The Δ*E* value expressed as a single value in the color difference L*, a* and b* was 15.16. Likewise, the luster (*L**) reduction and redness (*a**) increase of rice bran applied in the same heat treatment was reported by [18]. This outcome could be resulted from the formation of several products of *Maillard* reaction induced by heat treatment.

Table 2. Calorimetric analysis of both thermally treated corn bran (TTCB) and corn bran without heat treatment (CB)

	Color values			
Treatment	***L****	***a****	***b****	***ΔE***
CB	64.13	-3.24	25.06	
TTCB	49.31	-1.54	22.30	15.16

3.4. Determination of shelf life

3.4.1. Free fatty acids (FFA)

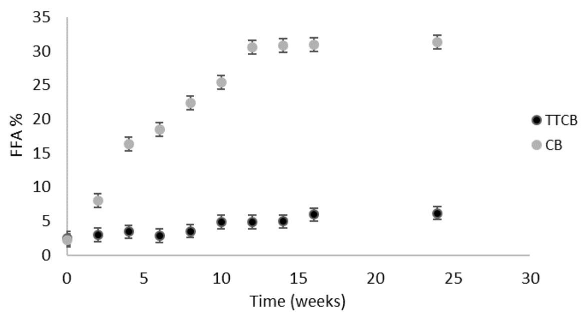

Figure 1. Free fatty acids content (FFA) in corn bran thermally treated (TTCB) and corn bran (CB) during 24 weeks of storage at room temperature

FFA content increased continuously with the storage time for CB (Figure 1) whereas for TTCB the FFA remained practically constant. This observed difference indicate that the applied heat treatment was efficient on retarding enzymatic degradation. A positive effect of thermic treatment was also perceived in studies with rice bran carried out by [18]. Hence, according to these authors, FFA content over 5% is considered harmful for human consumption. In this work, the FFA content in CB reached 5% in one storage week, while for TTCB this value was achieved in the 14th week.

3.4.2. Microbiological status

Microbiological parameters evaluated (Coliforms at 45°C, *Salmonella* sp. and *Bacillus cereus*) were within the established in RDC 12 [29] for both TTCB and CB, which were stored at room temperature during 105 days. Thus, the microbiological quality of TTCB and CB could be considered suitable for human consumption.

3.4.3. Micotoxicological status

The results found for mycotoxins shown in Table 3 were inferior to the maximum recommended by RDC 07 [30].

Table 3. Mycotoxicological status of thermally treated corn bran (TTCB) and corn bran without treatment (CB) after 105 days of storage

Mycotoxins	Samples		Limit [30]
	TTCB	CM	
Aflatoxin B and G (µg·kg^{-1})	4.9	6.5	20
Fumonisin B_1 and B_2 (µg·g^{-1})	850	870	1500
Zearalenone (µg·kg^{-1})	140	88	150

3.5. Analysis of mixtures' rheological properties

TTCB incorporation led to alterations in dough properties when measured by Farinograph (Table 4).

Table 4. Regression model adjusted for farinograph, alveograph and extensograph parameters

Farinograph parameters	Adjusted equation	Coefficient of determination
Water absorption (%)	WA = 54.33 + 0.77[TTCB]	0.96
Dough development time (min)	DDT = 8.10 - 0.02[TTCB]	0.44
Dough stability (min)	DS= 15.59 - 0.29[TTCB]	0.93
Mixing tolerance index (BU)	MTI = 10.71 + 2.57[TTCB]	0.89
Alveograph parameters	**Adjusted equation**	**Coefficient of determination**
Dough extensibility (mm)	L = 45.05 - 0.97[TTCB]	0.95
Dough curve configuration ratio	P/L = 1.86 + 0.16[TTCB]	0.75
Dough tenacity	W = 209.80 - 4.45[TTCB]	0.80
Extensograph parameters	**Adjusted equation**	**Coefficient of determination**
Extension strength (N)	Non-significant model	-
Extensibility (mm)	E = 30.46 -0.15[TTCB]	0.81
Curve proportionality	R/E = 1.39 + 0.01[TTCB]	0.64
Energy (g.mm)	EN = 971.20 - 8.39[TTCB]	0.93

[TTCB]= concentration of thermally treated corn bran. Regression analysis with significance level of 5%.

Water absorption (WA) increased significantly ($p<0.05$) with increasing TTCB concentration. Similar effects on WA were observed by [25,31,32] when working with barley bran and wheat bran, pea fiber and carob and mature barley grains with apple pulp, respectively. Reference [32] pointed out that WA differences among samples are principally caused by the greater quantity of hydroxyl groups that exist in the fiber structure and enables more elevated water absorption through hydrogen bonding interaction.

Dough stability (DS) diminished significantly ($p<0.05$) as TTCB concentration increased. Comparable outcomes were perceived by [31] for incorporation of oat bran and barley meal. Furthermore, DDT also decreased statistically ($p<0.05$) with TTCB concentration augment, where there was variation from 8.25 to 7.5 minutes. In the work carried out by [25] and [33], the fibers did not modify DDT.

MTI was also affected by TTCB addition. There was a MTI increase as higher concentrations of TTCB were being incorporated. In [34] study, an MTI enhancement was observed when working with apple pomace incorporation into wheat flour. MTI upsurge, according to [34], was resulted from gluten protein dilution with fiber content. This may also be due to the interaction between fibrous materials and gluten, which affects the dough. On the other hand, [35] noted that a MTI diminution by incorporating dehydrated green pea flour into wheat flour at 0-30% levels.

Dough extensibility (L) augmented with increasing TTCB concentration when assessed through alveograph. This relation was also detected by [25], when they worked with carob and pea fiber, probably due to interactions between fiber structure and wheat proteins. Extension strength (P), that is the dough capacity of retaining gas, could not be evaluated because there was none model that represented this variable. This was a consequence of the statistically significance of adjustment lackness.

The curve configuration ratio (*P/L)*, which provides information about resistance and extensibility were affected by TTCB addition, being enhanced when TTCB was incorporated. Similar relationship was observed by [25] when working with pea fiber. In this work, *P/L* increase was probably due to the elevated cellulose content presented in the fiber, which favored a strong interaction between fiber and wheat flour proteins [25].

Dough tenacity (W) was statistically reduced ($p<0.05$) by TTCB addition. Fiber incorporation promotes a marked decrease in proteolytic degradation [25].

Extensographic analysis provides information about viscoelastic behavior and measures both extension strength (*R*) and extensibility (E) of dough. It is noteworthy that an effective combination of strength and extensibility in dough properties is desirable by food industry [36].

Taking into account the increasing TTCB content, the extension strength (R) was not significantly altered ($p < 0.05$). Moreover, the extensibility values (E) decreased in this situation. This profile may be occasioned by gluten proteins dilution or interactions between polysaccharides and proteins from wheat flour [34]. Curve proportionality (R/E) augmented significantly ($p<0.05$) as TTCB was added, indicating that the dough became less flexible. R increase, E diminution and R/E ratio enhancement were also observed in [34] work, when studying apple pomace fiber incorporation into cake.

Energy (EN) was reduced significantly as TTCB was being added. References [31] and [32] also noted a reduction of EN when they incorporated mature barley grains and apple pomace into bread dough and rice bran, oats and barley respectively.

3.6. Incorporation of corn bran into dry tagliarini pasta

3.6.1. Moisture and water activity of pasta

Pasta moisture (M) enhanced significantly ($p < 0.05$) with corn bran incorporation (0 to 30%) as it can be seen in the equation M = 0.04[TTCB] + 8.62, R^2 = 0.93. All pasta formulations, containing 0 to 30% corn bran presented moisture inferior to 13%. An increase in moisture content was also observed in [37] work with the addition of sunflower, linseed and soybeans at concentrations of 0-40% in pasta. Water activity (a_w) presented none significant variation ($p < 0.05$) with corn bran incorporation. Thus, the mean a_w obtained was 0.59 ± 0.02.

3.6.2. Effect of Corn Bran Incorporation on Baking Quality

Corn bran incorporation caused a modification in pasta cooking quality as can be observed in Table 5.

Table 5. Regression model adjusted to pasta cooking parameters

Dependent variable	Adjusted equation	Coefficient of determination
Optimal cooking time (min)	OCT = 12.44 + 0.09[CBC]	0.95
Water absorption (%)	WA = 199.24 + 2.88[CBC] - 0.09[CBC]^2	0.84
Increase of volume (%)	IV = 1.66 + 0.02[CBC]	0.93
Cooking loss (%)	CL = 13.70 - 0.03[CBC]	0.90

[CBC] = corn bran concentration. Regression analysis with significance level of 5%, n=3.

The optimal cooking time of pasta increased significantly when corn bran was added. Reference [38], when assessing the effect of wheat bran incorporation on the quality of dry Chinese pasta also observed a linear augmentation of pasta cooking time as wheat bran was being adjoined (0-20%). Reference [16] perceived equal outcome when working with combinations of oat bran, *Psyllium* fiber, glucagel and inulin. An increase in cooking time was also pointed out by [13] when corn bran was incorporated into pasta at levels of 0-20%.

On the other hand, the literature also exhibits a cooking time decrease in the level of unconventional flours as presented in [39] study when insoluble dietary fiber was added into hard spaghetti. This behavior can be associated with the formation of a weaker gluten network as an outcome of gluten dilution effect [33]. In addition to water absorption competition among gluten, starch and fiber, which turn cooking process difficult.

Water absorption gradually increased ($p<0.05$) when TTCB was incorporated, obtaining a maximum TTCB point of 14.53%, which could be caused mainly due to a higher water retention capacity of bran fiber containing a greater number of hydroxyl groups when compared to the refined white wheat flour [40]. Reference [40] have also observed a significant enhancement of water absorption in wheat bran with superfine particle size in relation to control sample. However, [14] found that water absorption diminished significantly ($p < 0.05$) with the increasing quantity of flour enriched with aleurone. Reference [41] noticed equal behavior with water absorption of 192% for pasta elaborated with hard wheat and 166% for pasta made of guandu bean. In contrast, [13] did not detect significant difference in water aborption when corn bran was added into corn bran in pasta ate 0-20% level. The volume increase of mass enhanced considerably ($p <0.05$) as TTCB was being added.

TTCB addition reduced pasta cooking loss significantly, where the formulation containing 30% of TTCB decreased 8% the solids' loss in relation to standard formulation. Cooking loss (CL) represents a pasta quality factor, where increased cooking loss characterizes pasta low quality [14]. Increased solids' loss may be related to the presence of water-soluble components and gluten network weakening, which is responsible for amylose retention during cooking. According to [14], the addition of flour enriched with aleurone also did not reduce mass quality in relation to loss of solids due to the presence of proteins and fats existing in incorporated flour. Moreover, [42] found similar results for spaghetti fortified with chickpeas. In addition, [39] pointed out that insoluble fiber incorporation up to 30% level reduced solids' loss during cooking. In the study carried out by [41], cooking loss of about 5.6% was observed for dry wheat pasta and 7.0 and 6.8% for pea and fava beans, respectively. Reference [13] detected cooking loss with corn bran incorporation in pasta, with a level of 18,9-23% in the 0-20% substitution level.

3.6.3. Texture Parameters of Pasta

The texture parameters of pasta can be observed in Table 6.

Table 6. Regression model adjusted for the pasta dough texture

Dependent variable	Adjusted equation	Coefficient of determination
Hardness (g)	H = 8691.56 - 14.76[CBC]	0.64
Adhesiveness (g.s)	A = -120.27 + 1.61[CBC]	0.98
Firmness (g)	F = 109.88 + 0.08[CBC]	0.98
Shear force (g.cm)	SF = 7.95 - 0.02[CBC]	0.85

CBC = corn bran concentration. Regression analysis with significance level of 5%, n=3.

Hardness (H) corresponds to the force required to compress a pasta strip between the molar teeth [36]. H decreased significantly ($p < 0.05$) when corn bran was inserted at levels of 0 to 30%. In [38], wheat bran supplementation resulted in considerably inferior H to control at every level (5, 10, 15 and 20%). Moreover, in this study the particles size (0.21, 0.53 and 1.72) were also smaller than standard formulations, with the exception of 0.21 mm formulation with concentration of 5% wheat bran, which presented H superior to typical elaboration. In contrast, [41] observed a significant increase of H (38% and 43%) when fortified hard wheat pasta incorporating 35% of pea and fava beans, respectively.

Adhesiveness (A) augmented significantly ($p < 0.05$) when TTCB was added in different concentrations. Reference [14] noted that equal behavior, which could be linked to viscosity reduction. An adhesiveness' increase and consequently viscosity decrease may be resulted from available carbohydrates reduction, especially starch, which contributes to decrease the leaching material quantity [39]. However, adhesiveness rise may also be related to hardness and the presence of proteins and fats [14].

Firmness (F) represents the shear force required to penetrate pasta strips [41]. F augmented significantly ($p < 0.05$) when TTCB level increased in the pasta. Reference [14] observed equal behavior in F. In [39], there was also a considerable increase in all levels of insoluble fiber incorporation, with every incorporation being greater than control formulation. A feasible explanation for this effect may be due to the interaction of non-polar lipids with wheat flour starch. Apolar lipids when bound to starch granule are known to reduce the breakage thereof. This ensures a firm starch gel, and consequently a firmer product. In addition, these products would exhibit less leaching of amylose and amylopectin, which are responsible to increase viscosity [39].

Shear force decreased significantly ($p < 0.05$) with corn bran incorporation.

4. Conclusion

Corn bran utilization as food compound for human consumption and its feasible incorporation into dietary pasta is an option for citizens willing to improve their dietary nutritional quality.

The application of heat treatment into corn bran enhanced this product shelf-life from 1 to 14 weeks due to a reduction of enzymatic activity. Corn bran samples thermally treated complied with Brazilian legislation regarding total coliforms, coliforms at 45°C, *Bacillus cereus*, *Salmonella* sp. and mycotoxin content.

TTCB incorporation in the dough formulations affected the rheological properties, reducing the stability and dough development time as well as increasing the mixing tolerance index leaving the flour weaker. However, when assessing the alveographic and extensographic analyzes, it can be noted an increase in P/L and R/E ratio as well as a decrease in extensibility. This demonstrate a high resistance flour to extension, a desirable factor for pasta elaboration.

Moreover, TTCB addition into dry *tagliarini* pasta resulted in increased cooking time, enhanced volume, reduced cooking loss and absorption improvement up to the level of 14.53%. TTCB use also led to greater firmness and adhesiveness. Moreover, this treatment use has decreased hardness and shear force. Thus, it can be stated that the utilization of thermally treated corn bran up to 30% level in substitution of wheat flour for pasta production was feasible.

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