Journal of Food Technology 1 (4): 182-186, 2003

Discs for "Empanadas" with Whey Protein Concentrate

Cecilia E. Lupano
Centro de Investigación y Desarrollo en Criotecnología de Alimentos (CIDCA),
Facultad de Ciencias Exactas, UNLP-CONICET, 47 y 116, 1900 La Plata, Argentina

Abstract: The "empanadas", particularly meat "empanadas", are a traditional meal in Argentina. Discs for "empanadas" are home-made or industrially prepared and sold refrigerated. In this study the effect of the addition of low percentages of whey protein concentrate (WPC) to the paste of "empanadas" was analyzed. The rheological characteristics (alveograms and farinograms) of the dough, and the colour and other sensorial characteristics of cooked "empanadas" were studied as a function of the WPC content of the dough. The addition of WPC modifies the rheological properties of the paste, increasing the extensibility and decreasing the tenacity of the dough. This effect was not observed with heated WPC. The lactose content of the WPC produces browning reactions, improving the organoleptic characteristics and the acceptability of the "empanadas".

Key words: Rheological characters, traditional meal, WPC and argentina empanadas

Introduction

The "empanadas", particularly meat "empanadas", are a traditional meal in Argentina, adopting different characteristics in each geographical region of the country. Discs for "empanadas" are home-made or industrially prepared and are sold refrigerated. The paste for the discs of "empanadas" is desirable to have lower tenacity and higher extensibility than dough for breadmaking. Commercial products based on modified lactose have been developed to increase the extensibility and decrease the tenacity of doughs.

Dairy ingredients are used in breadmaking due to their nutritional and functional benefits. Whey proteins are primarily added to cereal products to improve nutritional properties, whey protein concentrate being considered the most efficient wheat protein supplement (Kenny *et al.*, 2000). Incorporation of dairy ingredients into wheat-based products improves their nutritional value by increasing the content of essential amino acids such as lysine, methionine, isoleucine and triptophan, having the advantage of their natural origin (Renz-Schauen and Renner 1987; Kadharmestan *et al.*, 1998 and Kenny *et al.*, 2001). Functional benefits of dairy ingredient incorporation include improvement of dough handling properties and some aspects of bread quality, as flavour, crust colour, toasting characteristics, and crumb structure and texture. Whey proteins exert negative effects on bread quality, by depressing loaf volume and increasing crumb firmness (Kenny *et al.*, 2000), but these effects do not represent a problem in the elaboration of discs for "empanadas". Previous assays indicated that WPC can disrupt the gluten network; in fact, gluten is not formed when WPC is present at an adequate concentration (Lupano 2000). The addition of WPC in bread dough produces a weaker and less elastic dough, probably because of the interference of WPC sulphydryl groups in the normal sulphydryl/disulfide interchange reactions occurring during dough development (Zadow 1981); but the denaturation of whey proteins eliminates this effect (Erdogdu-Arnoczky *et al.*, 1996 and Kadharmestan *et al.*, 1998).

The objective of this study was to analyze the effect of the incorporation of whey protein concentrate (WPC) to the paste of "empanadas" by up to 3.2% replacement of the flour. The rheological characteristics (alveograms and farinograms) of the dough and the sensorial characteristics of the cooked "empanadas" were studied as a function of the WPC content of the dough.

Materials and Methods

WPC was obtained by large scale ultrafiltration, and was a gift from Williner S.A. (Rafaela, Santa Fe, Argentine). WPC contained 5.1% moisture, 5.6% lipids, 5.95% ash, 49.3% protein (calculated as [total N (8.0%) – nonprotein N(0.3%)] × 6.38) and 32.3 % lactose, estimated by difference. In some cases, a WPC obtained by ultrafiltration and subsequent thermal treatment at 90°C with agitation during 45-60 s, referred as heated WPC (hWPC), was used.

Flour was type 0000, and was a gift from Molino Campodónico (S.A. Miguel Campodónico Ltda, La Plata, Argentine). Flour contained 10.0% protein and 13.6 % moisture.

Rheological Sudies: The rheological behavior of flour, flour with 1.6% WPC or hWPC, and flour with 3.2% WPC or hWPC, was analyzed through the farinograph and alveograph indexes (W = dough strength [$\times 10^{-4}$ J]; L = extensibility [mm]; P = tenacity [mm]) (Tosi *et al.*, 2000).

Preparation of hand-made "empanadas": Solid ingredients of dough were sifted three times. Dough was prepared by handly smearing corn oil through the solid ingredients and slightly wetting the mixture to form a cohesive dough. Ingredients were mixed for about 8 min and then held at room temperature for 30 min. Dough was sheeted with a rolling pin over a platform to give a sheet 2 mm thick. The sheeted dough was cut into discs of 7 cm diameter. Discs were filled and the empanadas were formed and cooked in an oven at 165° C during 30 min.

Ingredients: Dough: 300 g flour 0000, 1.85 % salt (Dos Anclas, Salinas Grandes, Hidalgo, La Pampa, Argentina), 0, 1.6 or 3.2 % WPC, 44 % (v/w) corn oil (flour basis)(Mazola, Refinerías de Maíz S.A.I.C.F., Escobar, Argentina), and about 30 % water (flour basis).
Filling: 250 g onion, 500 g minced meat, 4 boiled eggs, 10 green olives. 2.75 g salt, marjoram and cumin.

Color: Six "empanadas" of each group (prepared with dough containing 0; 1.6 or 3.2 % of WPC in a flour basis) were simultaneously baked and then allowed to cool at room temperature. The upside color of each "empanada" was measured three times using a colorimeter Minolta (Japan), and Hunter parameters a^*, b^*, and L^* were determined.

Sensory Evaluation: An analytical-descriptive test, category scaling type, was used to identify sensory characteristics and quantify them (IFT, 1981). Six panelists were selected to perceive differences between test products. Two coded samples, consisting in a control without WPC and a sample with 1.6 or 3.2 % WPC were presented simultaneously in a balanced order, which differs among the individual panel members. The evaluation of each pair of samples (control / 1.6 % WPC, and control / 3.2 % WPC) was performed in different days. Category scales consisting of a series of adjectival modifiers structured in descending order of intensity (very good, good, acceptable, poor, unacceptable) were used to measure the following attributes: appearance, color, texture, flavor, and general acceptability. Successive digits were later assigned to each point represented in the scale, from four to zero. An analysis of variance was used to determine significant differences among the mean scores for the samples represented.

Statistical Assays: All determinations were made at least in duplicate and averaged. The least significant difference was calculated at the 5% level. Sensory evaluation was performed by means of an analytical-descriptive test, category scaling type (IFT, 1981).

Results and Discussion

Rheological Studies: Fig. 1 shows the alveograph indexes of dough prepared with different WPC contents. The addition of WPC increased the extensibility of dough and decreased their tenacity. Whey proteins and lactose are the main components of

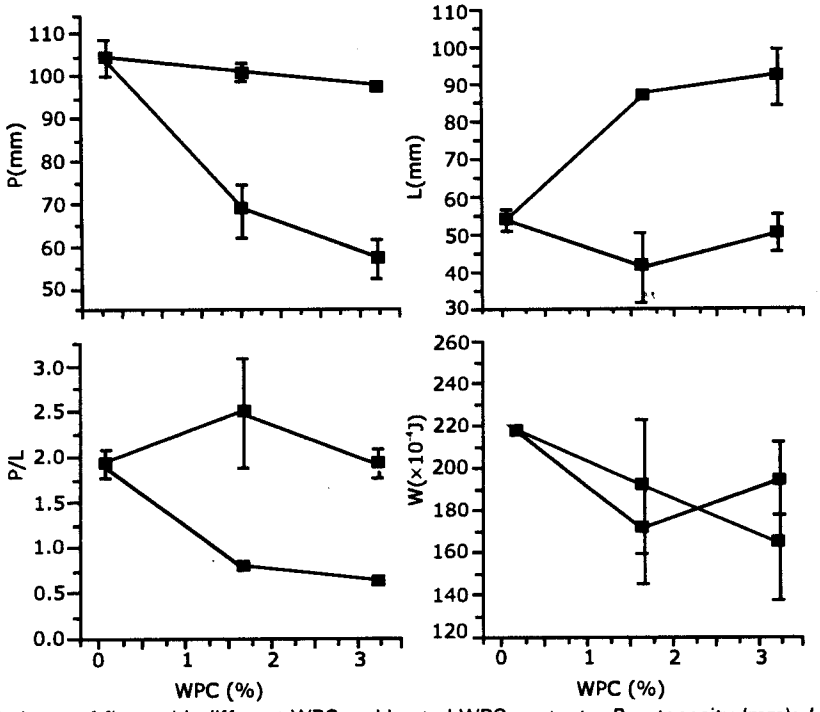

Fig. 1: Alveograph indexes of flour with different WPC and heated WPC contents. P = tenacity (mm); L = extensibility (mm); P/L = tenacity-extensibility ratio; W = dough strength ($\times 10^{-4}$ J). Bars show standard deviation. $LSD_{0.05}$ P = 10; $LSD_{0.05}$ L = 12; $LSD_{0.05}$ P/L = 0.55; $LSD_{0.05}$ W = 58

WPC, but, even when the addition of lactose modified the alveograph indexes (results not shown), the effect was less important than that observed with the addition of WPC. On the other hand, the addition of hWPC did not modify appreciably the alveograph indexes (Fig. 1). Whey proteins are thermal coagulated in hWPC, which indicates that these proteins must be in their native form to modify the rheological properties of dough. These results are in agreement with those obtained by Erdogdu-Arnoczky *et al.* (1996), and by Kadharmestan *et al.* (1998) in other wheat-based products.

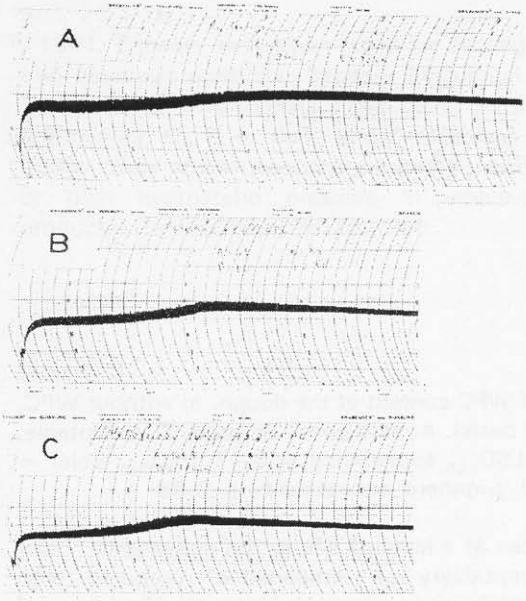

Fig. 2: Brabender farinograms of flour-WPC mixtures. A: flour without WPC; B: flour with 1.6% WPC; C: flour with 3.2% WPC

According to the model proposed by Belton (1999), gliadins contribute to the resistance to extension by forming a viscous environment, causing also a slowing down of elastic recovery. On the other hand, linear proteins (mainly high molecular weight glutenins) interact with each other by disulfide bonds and hydrogen bonds. Dough working favors the formation of end to end disulfide bonds in the subunits; this increases the effective molecular weight of the subunit and hence the number of linear-linear protein interactions and linear-globular protein interactions, increasing the resistance to deformation and the restoring force after deformation. Whey proteins would contribute to form a viscous environment like gliadins, having then a similar effect on the resistance to extension and decrease of the elastic recovery, but native whey proteins would also be able to form hydrogen and disulfide bonds with glutenin subunits, interfering in the normal structure of gluten. These results are in accordance with results obtained previously (Lupano, 2000) and with results observed by other authors (Zadow 1981 and Kadharmestan *et al.*, 1998), and with the fact that glutathione also causes dough weakening by sulphydryl/disulfide interchange reactions with gluten proteins (Grosch and Wieser, 1999). Aggregated whey proteins of heated WPC, on the other hand, would not have the ability to interact with gluten proteins.

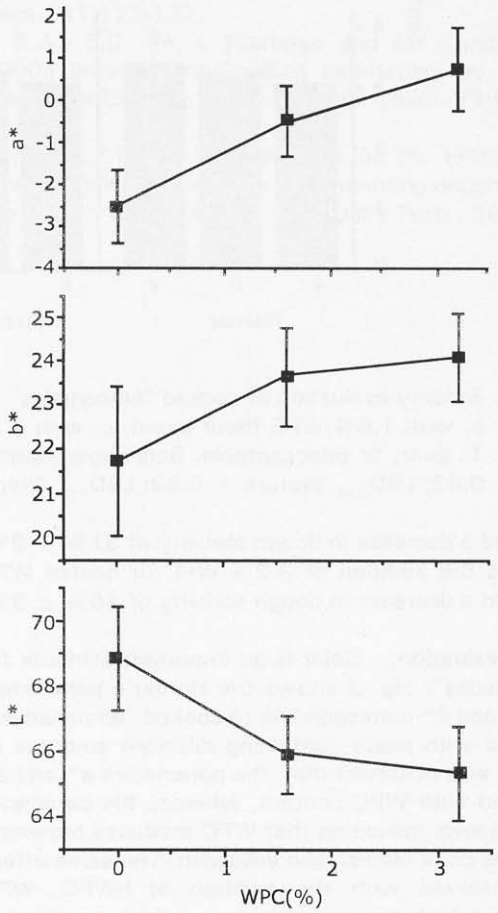

Fig. 3: Hunter parameters of cooked "empanadas" as a function of WPC content of the dough. Bars show standard deviation. $LSD_{0.05}$ a^* = 0.36; $LSD_{0.05}$ b^* 0.52 = ; $LSD_{0.05}$ L^* = 0.56

Fig. 2 shows the farinograms obtained with different WPC concentrations. The addition of WPC produced a decrease in the stability of the dough. This effect is not desirable and was produced by both WPC and heated WPC. The addition of 1.6% WPC or heated WPC

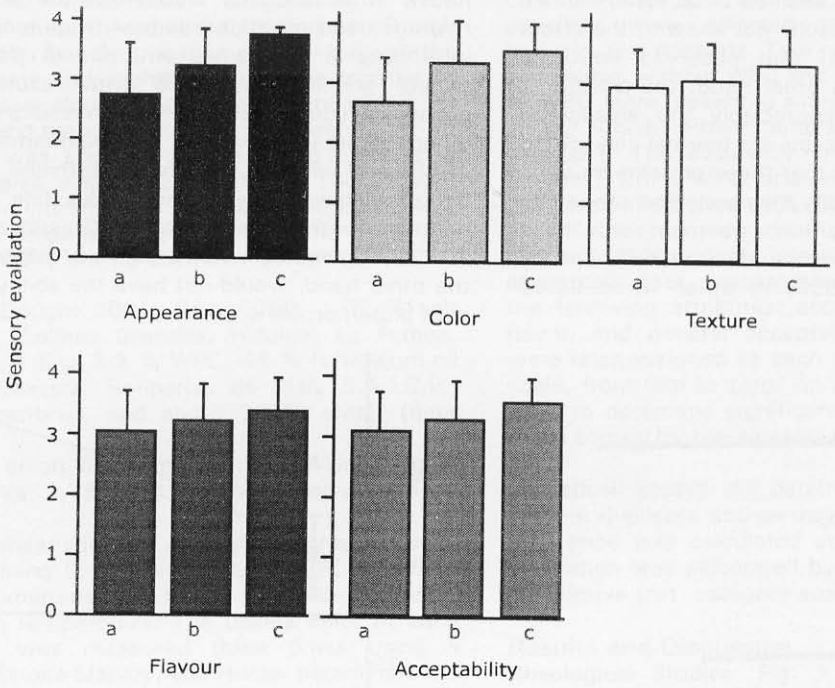

Fig. 4: Sensory evaluation of cooked "empanadas" as a function of WPC content of the dough. a: without WPC, b: with 1.6% WPC (flour basis), c: with 3.2% WPC (flour basis). 4: very good, 3: good, 2: acceptable, 1: poor, 0: unacceptable. Bars show standard deviation. $LSD_{0.05}$ appearance = 0.43; $LSD_{0.05}$ color = 0.42; $LSD_{0.05}$ texture = 0.39; $LSD_{0.05}$ flavor = 0.38; $LSD_{0.05}$ general acceptability = 0.36

produced a decrease in dough stability of 31% ± 9%, whereas the addition of 3.2% WPC or heated WPC produced a decrease in dough stability of 46% ± 9%.

Color Evaluation: Color is an important attribute for "empanadas". Fig. 3 shows the Hunter's parameters a^*, b^*, and L^* corresponding to cooked "empanadas", prepared with paste containing different amounts of WPC. It was observed that the parameters a^* and b^* increased with WPC content, whereas the parameter L^* decreased, indicating that WPC produces browning and turns color reddish and yellowish. The same effect was observed with the addition of hWPC. WPC contains a high amount of lactose, which contributes to the Maillard reactions. Differences at a level of significance of 5% were observed between samples with different WPC contents. Kadharmestan *et al.* (1998) obtained similar results in the parameter L^* of bread crumb fortified with commercial WPC.

Sensory Evaluation: Fig. 4 shows the results of a sensory test, in which the appearance, color, texture, flavor and acceptability of the "empanadas" were evaluated. Statistical assays show significative differences at a level of 5% in the appearance, color and acceptability of "empanadas" prepared with different WPC concentrations. Also, the dispersion of the results of the sensory evaluation decreased with WPC content. The main effect of WPC on the acceptability of these products is probably due to the browning reactions.

Conclusion

The addition of WPC can modify the rheological properties of the paste, increasing the extensibility and decreasing the tenacity of dough. This effect was not observed when coagulated WPC was added.

The lactose content of the WPC produces browning reactions, improving the organoleptic characteristics and acceptability of the "empanadas".

Acknowledgements

Author wish to thank Miguel Cardós and Leda Campaña for technical assistance in the rheolcgical assays. This investigation was supported by grant of the Agencia Nacional de Promoción Científica y Tecnológica, BID 1201/OC-AR, PICT 09-04423. Author C.E. Lupano is member of the Researcher Career of the

Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET).

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