Quality Of Potato Starch Bread

[1]Faouzia Nemar, [1]Abdelkader Dilmi Bouras, [1]Malika Koiche, [2]Joel Prodhomme, [2]Nasser-Eddine Assal

[1] Laboratory of Bioressources Natural Local, Faculty of sciences, university of H. B. Chlef, BP. 151, Chlef (02000)-Algeria.

[2] Groupe lactamel , Sidi Bel Abbes , Algeria.

Abstract

The corn, strategic food product, is very required on the international market. This request undergoes a strong pressure due to the growth of the world population and the changes of the food practices of certain people. The prices are thus unceasingly increasing. Immediate provisions must be taken in order to prepare to raise one demolished major which is food safety. The goal of this work returns in this context, we substituted the common flour of wheat by the potato flour (60/40, 50/50, 40/60, and 20/80). According to results of alveograph, tenacity, the extensibility and the deformation energy decrease with the increase in the rate of incorporation out of potato flour. This reduction was corrected by the vital gluten addition. The results show that nutritional quality is very close for the two flours. In addition, organoleptic analyse has

shown that the addition of the potato flour at a rate of 80% has given a bread with better characteristics: of structure (crust and crumb), of taste, color and odor. An alternative which can lower the pressure on the request of cereals and nourish significant populations in the world.

Key words: Bread, potato flour, flour of corn, substitution.

1. Introduction

The potato occupies the fourth world place, after cereal, rice and the corn, with is much higher than that of corn, it is respectively 20 tons and 1.5 tons per hectare (Kechid, 2005).

Among the many processed products, the potato starch is one of oldest. It constitutes a raw material significant in food industry because of its required properties. These last vary according to the composition, of the environment and the genotypes of potato (Lovedeep *et al.*, 2002; Zaidul et *al.*, 2007).

With the origin, the potato starch was produced for the panification, by adding it, with small percentages with the flour of cereals (Singh *et al.*, 2003). This addition helps to preserve the freshness of the bread and confer to him a distinctif character, pleasant savour and qualities of improved netting (Willard and Hix, 1987).

In this work we will substitute the common flour of wheat by high percentages of potato starch (60/**40**, 50/**50**, 40/**60**, and 20/**80**) in the preparation of the breads and then valuate the physico-chemical nutritional and sensory properties of the produced bread.

2. Material and Methods

2.1. Material

- The potato starch is provided by Michel COME, RAMBOUILLET, France;
- the standard flour of type 55, used is provided by the mill of NEKHLA, Chlef, Algeria;
- the yeast used is an instantaneous yeast baker.

2.2. Methods

2.2.1. Physico-Chemical Composition

a) Water Content

The water content of the samples is given according to standard AACC Official Methods 46-30, where a sample of 5 grams is weighed and placed in a dish with moisture. The sample is then heated with 130° C in a furnace with air during 2 hours (AFNOR, 1991).

b) Ash Content

It is given according to standard AACC Official Methods 08-01 (AACC, 1995).

A sample from 3 to 5 grams is weighed and then placed in a cup of ashes to be to heat with 900°C to complete combustion of the organic matter. The residue is refreshed with temp ambient temperature and then weighed (AACC, 1995; Wheat Center Marketing, Inc, 2004).

c) Content of Proteins

It is determined by the "method of Kjeldahl", which consists in measuring total nitrogen (N X 5,7). 2 G of dry samples weighed and placed hot with the concentrated sulphuric acid. The ammonia (sulphate of ammonia) is obtained after addition of sodium hydroxide is distilled in 1 M of boric acid, then titrated with 0,1 M of HCl. The estimated nitrogen value is multiplied by 5.7 (protein factor) to obtain the value of rough protein, expressed as a percentage mass of the dry sample (AACC, 1995).

d) Fat Content

The Soxhlet method (Ugrinovits *et al.*, 2004) was used to proportion the lipids. It consists with a hot extraction of the fat content contained in a solid sample. A quantity of 10g of the sample, crushed beforehand, is placed in the cellulose cartridge closed by cotton carded and

introduced into Soxhlet. The extraction is carried out by oil ether carried with backward flow during 6 hours. The solvents are then eliminated with evaporating rotary.

2.2.2. *Formulation of Panification*

The breads are formulated by incorporating the potato strach in different proportions (Table 1).

Table 1: Rapport de mélange (%) : fécule de pomme de terre : farine de blé

Sample S: Potato flour: flour of corn	Report/ratio of mixture
1	0 : 100 (control)
2	100 : 0 (control)
3	40 : 60
4	50 : 50
5	60 : 40
6	**80 : 20**

The breads were prepared by official method AACC (10 Process 10A), called to linear paste, with some modifications.

The pastes were prepared in a kneader (Clartonic, German) according to reports/ratios of caused mixtures, added with gluten, water, pressed yeast, salt and one improving of paste.
The mixer functions at a fallback speed (V1) during 5 minutes, then at a higher speed (V2) during 5 minutes. After mixture, the paste is left at rest during 25 minutes before a stage of fermentation of 90 minutes. The properties of gas retention during fermentation are evaluated using an indicator of growth containing 25 g of paste subjected to fermentation under the same conditions as the lumps.

Two types of hydration are carried out to compare the interest of a separate hydration of the potato starch before the addition of the flour of corn, and the method has consisting in mixing upon the departure the two types of flour.

The cooking of the breads is made with 220 °C during 20 minutes, in a furnace with a plate provided with a system of vapor injection.

2.2.3. Sensory Evaluation of the bread

The sensory characteristics of the breads of the potato starch are evaluated according to following properties: color and texture of the crust and the crumb, the flavor and acceptability. The appreciation of these characteristics is made by a jury made up of 20 tasters. The method of score of 5 Points (hedonistic scale) is used for the analysis sensory (Amerine *et al.*1973).

3. Results and discussion

3.1. Physico-chemical composition

The composition of the various breads obtained, with various percentages of potato starch and flour of corn, is virtually identical (Table 2).

Table 2: physicochemical composition of the two types of breads

Products	Moisture (%)	Glucides (%)	Proteins (%)	Lipids (%)
Corn bread	28,20	60,40	10,50	0,90
Potato flour bread (80/20)	31,33	61,36	6,87	0,37

The content of proteins of bread with the flour of corn, used at the time of this study, is about 0,90 %, result similar to that reported by Lindahl and Eliasson (1992) ; whereas that of the bread to the composite flour is 0,37%. According to Ugrinovits et *al.* (2004) the force of the flours is partly determined by their glutens wets. The vital gluten that we added at the time of the mixture made it possible to make up the proteinic deficit of the potato starch.

3.2. Test of panification in mixture

In order to determine the influence of the substitution of the flour of corn by the potato flour (20/80), several tests are carried out on the level of the laboratory and others on the level of bakery. Being given that the potato starch is unsuitable flour for making bread and thus difficult to handle we asked for the assistance of a French expert in panification (bread) (J. Prodhomme).

The rate of hydration is fixed so as to obtain a rather soft paste, but which remains façonnable (formable). The paste shows almost the same rheological characteristics as that of the pilot

bread (100% flour of common wheat), except that it has a less extensibility at the time of shaping.

This similarity in the results is due to the role of the added gluten; the essential element during the panification (especially during kneading and working), which plays a very significant role in the increase in the fixing water and the resistance of the paste. The composite paste, at 80% of potato starch presents one sticking more marked than that of the paste of flour of corn. This result confirms the conclusions reported by Roussel and Chiron (2002) how shows that the phenomena of sticking originate in:

- excess of hydration and thus U excessive relative moisture,
- bad quality of proteins,

In the same way, the properties of gas retention within the composite pastes are followed by measurement of the volume of the pastes during fermentation using the indicator of growth containing 25 g of paste subjected to fermentation under the same conditions as the lumps of the bread. The results obtained show that the pastes incorporating up to 80 % of potato starch raise less during fermentation but remains comparable with those obtained with corn 100% (Figure 1).

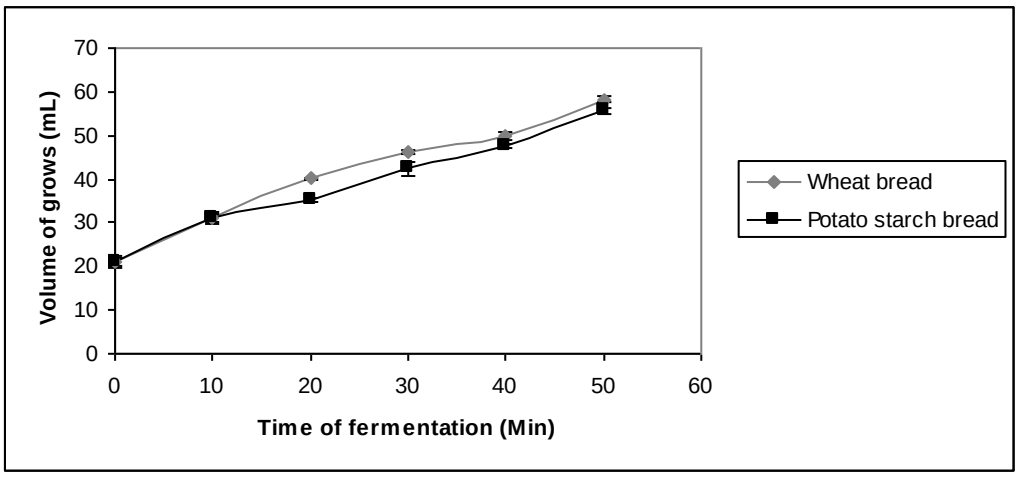

Figure 1: Influence incorporation of the potato flour on the profiles of gas retention

3.3. Organoleptic Qualities Of The Breads To The Potato Starch

3.3.1. Aspect Of The Bread

The appearances and interior of the breads obtained are represented in figures 2 and 3. The incorporation of the potato starch atrates of 80% gives breads to the optimal characteristics: good aspect, presenting regular crusts and smooth comparable with the breads resulting from the flour of corn. As for the coloration of the crust, the bread with the potato starch presents a less dark coloring compared to the breads at the flour of corn. However, we obtained breads with crust sunk well by maintaining cooking longer.

Dupin *et al.*, (1992) and Boyacioglu and Appolonia (1994) shows that the dark coloring of breads is influenced by the rise in damaged starch rate and the rate of total sugars present in the flour.

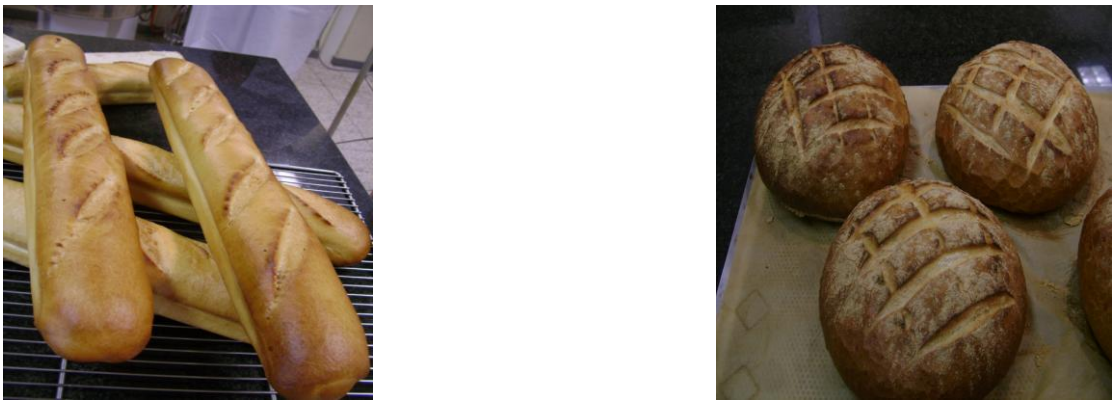

Figure 2: Aspect of crust of the breads with potato flour (80%)

The aspect of the crumb related to (Figure 3), the breads have aired, dispersed wells and almost homogeneous cells.

Figure 3: Aspect of the bread crumb with potato flour (80%)

Influence of the type of hydration: other tests are carried out for shown the influence of the type of the hydration on the final quality of the breads. Two types of hydrations are carried out: a separate hydration and a hydration of the whole of the composite flours. When a hydration of the unit is carried out, one obtains a paste with a short texture which tears and sticks oneself (low extensibility). During fermentation this paste inflates less better and subsides at the time of the setting to the furnace. However, the realization of a separate hydration where one prepares a potato strach paste containing the gluten before adding the flour of corn gives a paste a little more extensible, which inflates better during fermentation, and the resulting bread is bulkier and the structure of the crumb is developed better. Identical results were reported by Berthelot (1990) on mixtures of flours of cereal and corn where the density is improved of at least 40 % when one not of an hydration common to a separate hydration.

3.3.2. Total Acceptability

The breads with 80% of potato starch acquire a coloring and a very desirable texture, and from this fact they receive the highest note compared to the control bread (Figure 4).

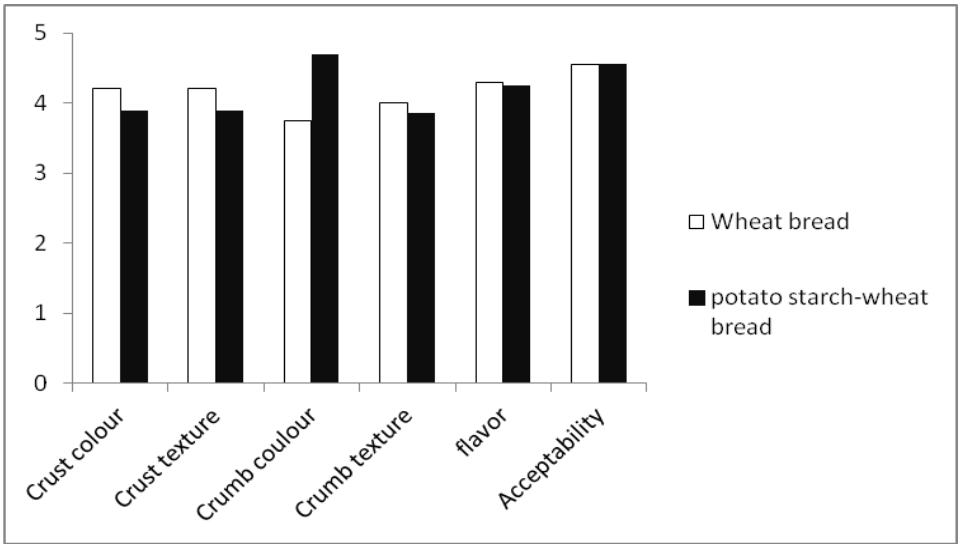

Figure 4: Appreciation of total organoleptic quality and the acceptability of the bread to 80% potato flour and 100% of flour of corn prepared in bakery.

The statistical analysis of the results of sensory quality of the bread shows that there is no significant difference ($p<0,05$) in the note of total acceptability, and of this fact the sensory characteristics of the breads with 80% of potato starch are not affected.

Conclusions

The results show that the breads can be prepared by the potato starch even to strong percentage (80%) and of gluten (percentage equivalent to that of the flour of corn). The breads obtained by this formula hare nutritional, physico-chemical and sensory characteristics almost identical to that of the ordinary breads (with flour of corn). A strong percentage of tasters see no difference between there. The results of this work could encourage the substitution of the flour of corn by the potato starch in the food products containing corn, at end to minimize the world pressures on cereals and to nourish significant populations in the world.

Bibliographical References

[1] Kechid M. Physiologie et biotechnologie de la microtubérisation de la pomme de terre *Solanum tuberosum. L.* Thèse de Doctorat 2005. Université de Constantine.

[2] Lovedeep K, Narpinder S, Navdeep SS. Some properties of potatoes and their starches II. Morphological, thermal and rheological properties of starches. J. Food Chemistry 2002; 79:183–192.

[3] Zaidul, ISM, Yamauchi H, Kim SJ, Hashimoto N, Noda T. RVA study of mixtures of wheat flour and potato starches with different phosphorus contents. *Food Chemistry*, 2007; 102(4) : 1105–1111.

[4] Willard MJ, Hix VM. Potato flour. In W. F. Talburt, & O. Smith (Eds.), Potato Processing (4th ed.) 1987; (pp. 665-681), New York: Van Nostrand Reinhold.

[5] AFNOR. Recueil de normes –contrôle de la qualité des produits alimentaires : céréales et produits céréaliers. AFNOR/DGCC RF. 3ème édition 1991; Paris. 360p

[6] AACC—American Association of Cereal Chemists. (). Approved methods of the AACC (9th ed.) 1995; St. Paul, Minnesota.

[7] Wheat Marketing Center, Inc. Wheat and Flour Testing Methods: A Guide to Understanding Wheat and Flour Quality, 2004; P 71. Portland, Oregon.

[8] Ugrinovits MS, Arrigoni E, Dossenbach A, Haberli G, Hanich H, Schwerzenbach J, Richemont L, Rychener M, Thormann H, Stalder U. Céréales, produits de l'industrie meunière, prémélanges pour four, mélanges de farines instantanées. Manuel suisse des denrées alimentaires, 2004; Chapitre, 14 : 19.

[9] Amerine MA, Pangborn RM, Roseller EB. Principles of sensory evaluation of food, 1973. New York and London: Academic Press.

[10] Lindahl L, Eliasson A. (1992). A comparison of some rheological properties of durum and wheat flour doughs, *Cereal Chemistry.* 69: 30-34.

[11] Roussel P, Chiron H. Les pains français : évolution, qualité, production. MAE-ERTI Editeurs. 2002 ; 433p, Paris.

[12] Dupin H, Cuq JL, Malewiak MI, Leynaud-Rouaud C, Berthier AM. Alimentation et nutrition humaines. Ed. : ESF éditeur, 1992; Paris. P : 745-747.

[13] Boyacioglu, MH, D'Appolonia BL. Characterization and utilization of durum wheat for breadmaking. 11. Study of flour blends and various additives. *Cereal Chemistry* 1994; 71(1): 28-34.

[14] Berthelot J.. La panification des céréales tropicales : mise au point de recettes de bros à dominance de maïs ou de mil aisément transférables en Afrique noire. Rapport de fin de programme. 1990 ; Paris : Ministère de la coopération et du développement, 64 p.