*J. Food and Dairy Sci., Mansoura Univ., Vol. 2 (6): 313 - 320, 2011*

# PRODUCTION OF LOW PROTEIN BALADY BREAD AND PAN BREAD

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## ABSTRACT

This study was designed to produce and evaluate low protein balady bread and pan bread made from different mixtures of wheat flour 82 % extraction with thermal treated corn starch and wheat flour 72 % extraction with corn starch. Two basic formulas were prepared to produce balady bread and pan bread. For each formula corn starch was added at levels of 10 %, 20 %, 30 %, 40 % and 50 % on the expense of wheat flour 82 % extraction to prepare balady bread and wheat flour 72 % extraction to prepare pan bread. Evaluation was made for chemical composition and organoleptic properties of the balady bread and pan bread. Results showed that, addition of starch led to a gradual decrease in total protein content in balady and pan bread. The maximum reduction of protein was observed in balady bread and pan bread at 50 % starch level. Fat, ash and crude fibers content were decreased at the expense of total carbohydrates. Addition of starch led to a slight decrease in specific volume but improved the organoleptic properties and overall acceptability. The best acceptable balady bread or pan bread were found in samples containing 40 % starch while low protein content was detected in samples of 5o %.

Substituting wheat flour with 40 % modified corn starch, the content of all amino acids in both balady bread and pan bread led to a decrease in all amino acids content, corresponding to decrease in PER values.

## INTRODUCTION

Low protein bread and bakery products are needed for specific diets as in some renal and hepatic diseases (Shile *et al.*, 1994). A normal adult needs to consume about 60 – 70 gm protein / day. While a patient with renal failure or hepatic coma requires low protein diet (< 20 – 40 gm protein/day) according to the degree of severity. Franck and Mitch, (2009) found that, for along time that patient with advanced chronic kidney disease can maintain neutral or slightly positive N-balance with protein intakes as low as 0.55 – 0.6 gm/kg.

The protein content of wheat flour ranges from 8 – 18 % depending on wheat variety and extraction rate of flour (Pena and Balance, 1987 and Atia, 1995). Addition of starch to flour led to an increase in total carbohydrates and calories, while total lipids, protein and gluten were decreased. Also, falling number was decreased as reported by authors.

(Emam, 1997), found that using of wheat flour first break and corn starch at 40 % level gave good quality cakes with longer shelf life, but best results were obtained when emulsifier and baking powder mixture was used.

This study was designed to produce low protein balady bread and pan bread made from different mixture of wheat flour (82 % and 72 % extraction) with modified corn starch and to evaluate the balady bread and pan bread for chemical, physical and organoleptic properties.

## MATERIALS AND METHODS

**Materials:-**

1- Wheat flour (82 % and 72 % extraction rate) was obtained from the South Cairo Mills Company, Cairo, Egypt.
2- Corn starch was purchased from local market.

**Methods:-**

**1- preparation of modified corn starch:-**

The corn starch was spreaded in aluminum trays with 5 mm height, then the trays were put in an electric oven at 130 °C for 7 hrs. The produced dextrin was cooled as rapidly as possible to prevent over converts. (Hussein *et al.*, 2009).

**2- Baking methods:-**

(a) Balady bread prepared according to the method described by Abd el-Rahim (2005). Gelatinization method as described. 50 % of amount of wheat flour 82 % extraction in a mixing bowl. Boiled water (40 % w/w) was added and mixed for 3 min. added the remainder amount of wheat flour and salt. During mixing, cold tap water slowly added (40 to 60 % w/w) to produce suitable dough consistency (about 15 min). Yeast was added at the end of mixing time or when the dough become warm, continue as described in traditional method to bulk fermentation, dividing, flattened, fermentation, baking at 450 – 500 °C in mechanical natural gas oven for 60 – 90 seconds and cooled before evaluation.

(b) Pan bread was baked according to the AACC (2002) method. Dough constituents were: wheat flour 72 % extraction (100 – 50 %). Modified corn starch (0 – 50 %, salt (2 %), yeast (1.5 %), oil (5 %) and ( 5 %) sugar were placed in the mixer and then mixed with water until optimum consistency was obtained. The dough was removed from the mixer and rounded, molded and put in panneel (5x9x8 cm) tightly greased pan to prevent the sticking of resulted bread. Fermentation process was carried out for 90 min at 30 °C and 85 % relative humidity after proofing bread was backed approximately 15 min in a Chopin laboratory oven at 260 °C

**Chemical analysis:**

Moisture, crude protein, fat, total carbohydrate, ash and gluten content were determined according to the methods described in AOAC (2000). Total carbohydrates were calculated by difference and total energy was estimated (calories/100gm).

**Organoleptic evaluation:**

Sensory evaluation of balady bread and pan bread was carried out according to the method of Fairdi and Rulenthaler (1984).

**Stalling of balady bread loaves:**

The stalling of balady bread and pan bread was determined by alkaline water retention capacity according to the method described by yamazaki (1953) and modified by Kitterman and Rubenthaler (1971).

**Determination of amino acids:**

The amino acids content of balady bread and pan bread were determined using HPIC (Pico-Tag) method according to Cohen *et al.* (1989).

**Biological values:**

Biological value of balady bread and pan bread were determined on the basis of their amino acid profiles. Protein efficiency ratio (PER) was estimated according to the following regression equation proposed by Alsmeyer *et al.*(1974).

PER= -0.468+0.454 (leucine) -0.105 (tyrosine ).

## RESULTS AND DISCUSSION

The study aims to develop low protein bread for dietetic purposes. The main source of protein in bread are wheat flour 82 % extraction, wheat flour 72 % extraction. Thus, the work was planned to use suitable substitutes with modified corn starch to decrease the protein content. Modified corn starch was added to wheat flour 82 % and 72 % extraction at different levels (10 %, 20 %, 30 %, 40 % and 50 %) (Table 1).

**Table (1): Formulation of balady bread and pan bread with modified corn starch.**

| Samples* | Wheat flour gm | Modified corn starch % | Yeast % | Oil % | Sugar % | Salt % |
|---|---|---|---|---|---|---|
| Balady bread (wheat flour 82 % ext.) Formula (A) | 100 | - | 1 | - | - | 1.5 |
| | 90 | 10 | 1 | - | - | 1.5 |
| | 80 | 20 | 1 | - | - | 1.5 |
| | 70 | 30 | 1 | - | - | 1.5 |
| | 60 | 40 | 1 | - | - | 1.5 |
| | 50 | 50 | 1 | - | - | 1.5 |
| Pan bread (wheat flour 72 % ext.) Formula (B) | 100 | - | 1.5 | 5 | 5 | 2 |
| | 90 | 10 | 1.5 | 5 | 5 | 2 |
| | 80 | 20 | 1.5 | 5 | 5 | 2 |
| | 70 | 30 | 1.5 | 5 | 5 | 2 |
| | 60 | 40 | 1.5 | 5 | 5 | 2 |
| | 50 | 50 | 1.5 | 5 | 5 | 2 |

Data tabulated in table (2) indicated that, wheat flour 82 % extraction contained higher contents of ash, fat, fiber and protein, while wheat flour 72 % extraction recorded lower carbohydrate content and energy than wheat flour 82 % extraction. These results are in agreement with results obtained by (El-Adly and El-Gendy, 2009).

**Table (2): Chemical composition of raw materials (gm/100g on dry weight basis)**

| Chemical analysis | Protein % | Fat % | Ash % | Fiber % | Carbohydrates % | Energy (Kcal) |
|---|---|---|---|---|---|---|
| wheat flour 82 % extr. | 12.2 | 1.4 | 1.03 | 1.2 | 84.17 | 398.08 |
| wheat flour 72 % ext. | 11.2 | 0.77 | 0.51 | 0.7 | 86.82 | 399.01 |

*** Average of duplicate determination**

The wheat flour and modified corn starch mixture were further studied for gluten content. Data presented in Table (3) show that there was a noticeable decrease in the gluten content when the amount of added starch increased. The gluten function is chiefly as a dough binding agent and it is not essential for crumb structure (Pomersnz, 1971). Thus low gluten content in the studied mixtures would resemble the soft wheat flour which is being used for bread and biscuits formulation.

**Table (3): Effect of starch addition to wheat flour on gluten content (on dry weight basis)**

| Samples* | | Dry gluten | % decrease |
|---|---|---|---|
| Balady bread (Formula A) | Control (100 % W.F.) | 11.8 | - |
| | Control + 10 % starch | 10.6 | 10.2 |
| | Control + 20 % Starch | 9.4 | 20.3 |
| | Control + 30 % starch | 8.3 | 29.7 |
| | Control + 40 % starch | 7.1 | 40.7 |
| | Control + 50 % starch | 6 | 49.1 |
| Pan bread (Formula B) | Control (100 % W.F.) | 10.9 | - |
| | Control + 10 % starch | 9.8 | 10 |
| | Control + 20 % Starch | 8.7 | 20.1 |
| | Control + 30 % starch | 7.5 | 31.2 |
| | Control + 40 % starch | 6.5 | 40.3 |
| | Control + 50 % starch | 5.4 | 50.4 |

*** Average of duplicate determination**
**- W.F.: Wheat flour**

The chemical composition of prepared bread are presented in Table (4). Results showed that, the protein content was gradually decreased as a result of increasing levels of modified corn starch. The lowest protein content was found in the samples blended with 50 % starch (4.5 – 6 gm/100gm). This agree with Garibotto *el al.*(2010) who found that, a low protein diet containing 0.6-0.7 gm/kg is nutritionally safe in chronic kidney disease patients.

Meanwhile, fat, ash and crude fiber contents of all bread (balady and pan bread) were decreased as the amount of modified corn starch substitute increased. In contrast, modified corn starch addition to the flour led to increase in the total carbohydrates. This trend of results were found by (Hussein and Al-Akeli, 1993).

On the other hand, bread made from the mixtures of formula –B (pan bread) showed a relatively lower content of protein compared to these of formula A (balady bread).

Results in Table (5) show that modified corn starch improved the organoleptic properties of all produced bread comparing to control bread. Addition of modified corn starch with 40 % to the flour in both formulas (A and B) recorded the highest score for all tested characters as well as overall acceptability. This may be due to its high starch content (Emam, 1997). Generally, bread of formula B (pan bread) recorded high score of some characters or overall acceptability comparing with bread of formula A (balady bread) (Mohamed *et al.*, 1995).

**Table (4): Chemical constituents of produced bread from wheat flour and different levels of modified starch (g/100g on dry weight basis)**

| Samples* | | Protein % | Fat % | Ash % | Fiber % | Carbohydrates % | Energy (Kcal) |
|---|---|---|---|---|---|---|---|
| Balady bread (Formula A) | Control (100 % W.F.) | 12.2 | 1.4 | 1.03 | 1.2 | 84.17 | 398.08 |
| | Control +10 % starch | 10.6 | 1.2 | 0.9 | 1.07 | 86.23 | 398.12 |
| | Control +20 % Starch | 9.4 | 1.1 | 0.81 | 0.95 | 87.74 | 398.46 |
| | Control +30 % starch | 8.3 | 0.96 | 0.73 | 0.82 | 89.19 | 398.60 |
| | Control +40 % starch | 7.1 | 0.81 | 0.61 | 0.71 | 90.77 | 399.13 |
| | Control +50 % starch | 6 | 0.7 | 0.5 | 0.62 | 92.16 | 399.20 |
| Pan bread (Formula B) | Control (100 % W.F.) | 11.1 | 0.77 | 0.5 | 0.71 | 86.92 | 399.1 |
| | Control +10 % starch | 10 | 0.66 | 0.44 | 0.63 | 88.27 | 399.02 |
| | Control +20 % Starch | 8.9 | 0.60 | 0.40 | 0.57 | 89.53 | 399.12 |
| | Control +30 % starch | 7.8 | 0.51 | 0.34 | 0.50 | 90.85 | 399.19 |
| | Control +40 % starch | 6.6 | 0.43 | 0.30 | 0.41 | 92.26 | 399.31 |
| | Control +50 % starch | 5.4 | 0.36 | 0.24 | 0.33 | 93.67 | 399.52 |

*** Average of duplicate determination**

**Table (5): Organoleptic evaluation of balady bread and pan bread.**

| Sample* | | Broofrising (10) | Crust quality (10) | Crust color (10) | Crumb uniformity (10) | Crumb color (25) | Odor (10) | Taste (25) | Overall acceptability (100) |
|---|---|---|---|---|---|---|---|---|---|
| Balady bread (Formula A) | Control (100 % W.F.) | 9 | 8 | 9 | 8 | 23.5 | 9 | 24 | 90.5 |
| | Control +10 % starch | 8.5 | 8.5 | 9 | 8.5 | 23.5 | 9 | 24 | 91 |
| | Control +20 % Starch | 8.5 | 8.5 | 9 | 8.5 | 23.5 | 9 | 24 | 91 |
| | Control +30 % starch | 8 | 8.5 | 9.5 | 8.5 | 24 | 9 | 24.5 | 92 |
| | Control +40 % starch | 8.5 | 8.5 | 9.5 | 8.5 | 24 | 9 | 24.5 | 92.5 |
| | Control +50 % starch | 8 | 8.5 | 9.5 | 8 | 24 | 9 | 24.5 | 91.5 |
| Pan bread (Formula B) | Control (100 % W.F.) | 9 | 8 | 8 | 9 | 24 | 9 | 24 | 91 |
| | Control +10 % starch | 9 | 8.5 | 9 | 8.5 | 24 | 9 | 24 | 92 |
| | Control +20 % Starch | 9 | 8.5 | 9.5 | 8.5 | 23 | 8 | 24 | 90.5 |
| | Control +30 % starch | 8.5 | 8.5 | 9.5 | 8.5 | 24.5 | 9 | 24 | 92.5 |
| | Control +40 % starch | 8 | 8.5 | 9.5 | 9 | 24.5 | 9.5 | 24 | 93 |
| | Control +50 % starch | 8 | 8.5 | 9.5 | 8 | 24.5 | 9 | 24 | 91.5 |

*** Average of duplicate determination**

Table (6) show the Alkaline water retention capacity of balady bread and pan bread formulas at zero time and after storage periods for 24 and 48 hours. The results showed that the hydration capacity (H.C) was decreased by increasing the storage periods.

**Table (6): Effect of modified starch on hydration capacity (H.C.) of produced balady bread and pan bread after zero time, 24 and 48 hr.**

| Samples* | | Times | | |
|---|---|---|---|---|
| | | Zero time | After 24 hr. | After 48 hr. |
| Balady bread (Formula A) | Control (100 % W.F.) | 319 | 278 | 245 |
| | Control +10 % starch | 333 | 314 | 290 |
| | Control +20 % starch | 352 | 332 | 317 |
| | Control +30 % starch | 378 | 366 | 355 |
| | Control +40 % starch | 399 | 390 | 380 |
| | Control +50 % starch | 428 | 419 | 412 |
| Pan bread (Formula B) | Control (100 % W.F.) | 203 | 143 | 95 |
| | Control +10 % starch | 223 | 203 | 180 |
| | Control +20 % starch | 235 | 214 | 198 |
| | Control +30 % starch | 249 | 241 | 234 |
| | Control +40 % starch | 264 | 259 | 252 |
| | Control +50 % starch | 285 | 280 | 274 |

* Average of duplicate determination

Results in Table (7) showed the amino acid composition and protein efficiency ratio (PER) of balady bread and pan bread . Substituting wheat flour with 40 % modified corn starch for both balady and pan bread led to a decrease in all amino acids contents, Corresponding to decrease in PER values.

**Table (7): Amino acid contents of balady bread and pan bread (gm/100g protein) and protein efficiency rotio (PER) .**

| Samples / Amino acids | Balady bread wheat flour 82 % ext. (control) | Balady bread (wheat flour 82% ext.+40% modified corn starch) | Pan bread wheat flour 72 % ext. (control) | Pan bread (wheat flour 72% ext. +40% modified corn starch) |
|---|---|---|---|---|
| Isoleucine | 3.35 | 1.91 | 3.45 | 1.93 |
| Leucine | 6.80 | 3.92 | 6.82 | 3.89 |
| Lysine | 1.98 | 1.01 | 1.58 | 0.87 |
| Methionine | 2.60 | 1.45 | 1.65 | 0.91 |
| Cystine | 0.80 | 0.31 | 1.58 | 0.89 |
| Phenyl alanine | 6.20 | 3.80 | 4.33 | 2.55 |
| Tyrosine | 2.70 | 1.67 | 2.14 | 1.18 |
| Threonine | 2.42 | 1.39 | 2.50 | 1.49 |
| Valine | 3.50 | 1.95 | 3.77 | 2.01 |
| PER | 2.34 | 1.34 | 2.40 | 1.18 |

The data are partially compatible with literature reported which indicated that human body responds to decrease in protein intake with several sequential metabolic changes including a reduction in amino acid

oxidation, a decrease in protein degradation and ultimately a decrease in protein synthesis . This will cause long time neutral or slightly positive N-balance in patients with advanced chronic kidney disease (Garibotto *et al.*, 2010).

**Conclusion**

With regard to the main aim of this study to produce bread (balady and pan bread) containing low protein content of high organoleptic properties. It can be concluded that using modified corn starch at (30 % - 40 %) gave an acceptable bread (balady and pan bread) with low protein content.

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## انتاج خبز بلدى وأفرنجى منخفض فى نسبة البروتين

**عبدالله سعيد أمام حسين، نبيل عبدالفتاح العدلى و هالة سعد سيد**
**معهد بحوث تكنولوجيا الآغذية – مركز البحوث الزراعية – جيزة**

يهدف هذا البحث الى انتاج خبز بلدى وأفرنجى منخفض فى نسبة البروتين ليلائم أولئك الذين يعانون من قصور فى الوظائف الفسيولوجية للكلى حيث تم إستخدام دقيق القمح إستخلاص ٨٢ % لإنتاج الخبز البلدى ودقيق القمح إستخلاص ٧٢ % لإنتاج الخبز الأفرنجى مضافا اليهم نشا الذرة المعامل حراريا بتركيزات مختلفة ١٠ ، ٢٠، ٣٠ ، ٤٠ ، ٥٠ % .

وتم تقدير التركيب الكيماوى والصفات الحسية للخبز البلدى والأفرنجى المعامل بنشا الذرة المعامل حراريا.

وأوضحت النتائج أن إضافة النشا المعامل حراريا أدى الى إنخفاض فى نسبة البروتين فى الخبز البلدى والأفرنجى وكانت أعلى نسبة أدت الى إنخفاض البروتين هى إضافة النشا بنسبة ٥٠ % لكل من الخبز البلدى والأفرنجى.

كما أدت إضافة النشا الى إنخفاض كل من الدهون الكلية والرماد والالياف وحدث زيادة فى نسبة الكربوهيدرات الكلية بزيادة معدل الإضافة كما أظهرت التقييم الحسى للخبز البلدى والأفرنجى المصنع باستبدال نشا الذرة المعامل حراريا بنسب ١٠ ، ٢٠، ٣٠ ، ٤٠ ، ٥٠ % الى تحسين فى الصفات الحسية مقارنتا بالعينة القياسية. وكانت أحسن نسبة للأستبدال للقبول الحسى لكل من الخبز البلدى والأفرنجى هى ٤٠ % .

وأوضحت النتائج أن إضافة النشا المعامل حراريا بنسبة ٤٠٪ الى دقيق القمح في كلا من الخبز البلدى والافرنجى أدى الى إنخفاض في محتوى كل الاحماض الامينية وكذلك نقص في معدل كفاءة البروتين.

**قام بتحكيم البحث**

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