Iranian Journal of Science & Technology, Transaction A, Vol. 29, No. A1
Printed in The Islamic Republic of Iran, 2005

EVALUATION OF DIFFERENT TYPES OF DOUGH FOR PASTAS*

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Abstract – Protein content and its effect on the quality of fresh pastas, obtained from dough prepared with different formulas: semolina, wheat flour, gluten, wheat bran and soybean proteins, were evaluated in this paper. Tests were carried out in the laboratory using raw materials from the same batch national origin. Raw materials were mixed in an auxiliary kneading machine with a 500 g -capacity. The dough was then stretched and cut manually into long strings of spaghettis of 2 mm- diameter. The following parameters were analysed in 7 different doughs: a) Protein content, b) Humidity, c) Solid content in the cooking water d) Sensorial analysis: colour, aroma, flavour and solidity. Results showed that the best dough samples, from a sensorial point of view, had the following composition: 1) "000"-flour: 85% and gluten: 15%, and 2) "000"-flour: 60%, semolina: 30% and gluten: 15%. The highest percentage of proteins was determined in these types of dough. The soybean flour addition was not satisfactory, considering the characteristics of aroma and flavour. Neither was the wheat bran addition, since it altered the texture of the dough, not being appetizing for the consumer.

Keywords – Pasta, high protein content, spaghettis, sensorial analysis

1. INTRODUCTION

The generic name *pasta* includes products obtained from flour mixtures, dried or not, in a non-fermented dough with or without the addition of eggs. The commercial names (macaroni, spaghetti, vermicelli, cannelloni, etc.) allude to products of different shapes and sizes. In the United States, pasta that contain yoke are called "noodles" and those that do not, macaroni [1].

The spread of pasta manufacturing outside Italy started in the period between World War 1 and World War 2. It was at that time that a large number of Italian immigrants and pasta manufacturers settled in our country.

At present, Argentine society, a large pasta-consuming market, is not indifferent to the world trend towards diet products which considers pasta a negative element due to its high carbohydrate content, and consequently, undesirable for restricted calorie diets.

Keeping this idea in mind, it is important for the present noodle industry to find out alternative mixtures for noodles with high protein and low carbohydrate content.

Classic pasta are the result of the extrusion of a mixture of durum wheat semolina or noodle wheat, according to the Argentine Food Code (CAA), and water that are later consumed fresh or submitted to a drying process.

Under different climatic and agricultural conditions, cereals naturally present variations in the quality of the pasta obtained from them. In industrialized countries the pasta made from durum grain

*Received by the editor November 13, 2002 and in final revised form October 2, 2004
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semolina is preferred. For economic reasons and a new market for low calorie products, there is a trend for using lower priced raw matter with a smaller starch and higher fibre content whenever the final product is of fairly good quality and acceptable [2].

If in the classic pasta mixtures, part of the semolina is substituted by gluten, whole soybean, bran or corn flour, proteins and fibres will be increased and carbohydrates decreased, resulting in diet pasta acceptable to consumers [3], [4].

In this work, different combinations of flours are analysed in order to find mixtures that fulfil the properties of diet pasta on the basis of the analysis of proteins, amount of solids in the cooking water and parameters of consumer acceptance in cooked pasta such as colour, flavour, aroma and solidity.

2. MATERIALS AND METHODS

The CAA calls *noodles* or *fresh pasta* with Saracen or durum wheat flour and wheat flour, the unfermented product whose pasting or kneading is made with a mixture of flour (art. 661) and Saracen wheat flour.

All tests were carried out in the laboratory using wheat flour, semolina, gluten, wheat bran, corn flour and whole meal soybean flour in 7 different combinations (Table 1) based on the data from previous works on low calorie pastas.

Table 1. Proportions used in the different mixtures

Mixtures	"000" flour	Semolina	Gluten	Wheat bran	Corn flour	Soybean flour
1	75	0	15	10	0	0
2	85	0	15	0	0	0
3	30	66	0	0	0	4
4	0	85	0	0	10	5
5	20	60	10	10	0	0
6	30	60	10	0	0	0
7	55	30	15	0	0	0

The raw materials used were as follows:

The main component in noodle manufacturing is wheat flour, which, according to the CAA, is the product obtained from the milling of wheat grain endosperm. The chemical composition of a flour (of about 73-74 % of extraction) is similar to a "000" flour taking into account that, since it is a flour to be used for noodles, it should be quite white, with a starch percentage lower than that of bakery flour and a higher gluten percentage.

Semolina is the granulose product obtained from the industrial endosperm break-up of Candeal Wheat, free from foreign substances or impurities, of a size between fine semolina and flour and characterized by the CAA through granulometry as having a mesh of 66/64 (250 u): no residue, and a mesh of 12 xx (100 u): 90 % residue.

Gluten or gluten flour is the dried and powdered product obtained or left after the removal of almost all starch content from the wheat flour. It has high amounts of store proteins (gliadins and glutenins), low albumin content and other proteins. It contains a maximum of 12 % starch, 75-80 % protein and 10 % humidity.

Wheat bran is the milling residue of the different varieties of the wheat grain composed of the grain husk (pericarp) mixed with surface albumen (endosperm).

Corn flour is the product obtained from the floury endosperm, resulting from the milling of clean, whole and well-preserved grains of *Zea mays* L. with a water content no greater than 13.5 %, a nitrogen content no lower than 1.12 % and a maximum of 3 % fat.

Soybean whole meal flour is a valuable source of vegetable protein with 79 % total nitrogen on a dry base (TDN), as well as minerals and vitamins [5].

In the preparation of the mixtures, no more than 10 % bran was used to avoid problems in the cooking of the pasta and in the mechanical behaviour [3], and no more than 5 % soybean flour, to prevent the bean taste present in this flour [6], [7].

The raw materials were mixed in an auxiliary 500 g-capacity kneader. Then, the mixtures were prepared, and after the addition of 35 % water, kneaded, stretched out in a manual processor and cut off as long noodles of 2 mm-thick and 1 cm-wide. Five runs were made with each treatment with their respective replications.

The dough obtained was submitted to a protein analysis (according to Kjeldhal's method, N x 5.7), and to an analysis of humidity in fresh dough [3 h at 105 ºC and controlled pressure (vacuum)]. Solid residues were also determined in the cooking water through refractometry in the cooked pasta.

The dough acidity was determined in order to know the decomposition grade and storage conditions of the flour employed in the different mixtures. Acidity of the aqueous solutions was determined by pH determinations at 25 ºC. The obtained pH values between 6.1 and 6.2 are considered acceptable by the CAA [8].

A group of 10 half-trained panellists carried out the sensorial evaluation by evaluating the colour, aroma, flavour and solidness of the cooked pasta using a 1-10 scale.

Colour was determined as the intensity of the colour of the pasta ranged from the lighter to the darker hues (0=unpleasant; 10=pleasant).

Aroma and flavour were determined by the intensity of the aroma or taste of the raw cereal characteristic of pasta, but constituting a defect if it was too intense (0=pleasant; 10=unpleasant).

Solidity was evaluated if the first bite was strong enough to break off the pasta, and by agreement between the evaluators, the value "al dente" was rated as 6, and the range of acceptance 5-7.

The data of protein content, amount of solids in the cooking water and sensorial analysis were reported as mean value and standard deviation (SD).

3. RESULTS AND DISCUSSION

Results were arranged in tables and the literature review was used to analyse the physical data as well as the evaluators' preferences.

From the point of view of solid content (see Table 2), only two mixtures (2 and 7) were classified as excellent (below 6 % of solid content), while mixture 1 was classified as technologically acceptable (by around 8%). However, the others were considered lower quality (over 10%). According to Adams [9], this is due to the addition of lower quality flours such as soybean or wheat in the mixtures that, when present in pasta, result in an increase in solids content. The formation of a non-resistant crystalline net whose break-up during cooking increases the amount of solids.

The determination of humidity of each sample was done in fresh pasta before analysing proteins in order to refer all the mixtures to a dry sample and make them comparable (see Table 2).

Table 2. Amount of solids in the cooking water, proteins and humidity contents in fresh pasta for each mixture

Mixtures	% Solids	% Proteins	% Humidity
1	8.18 ± 0.18	26.96 ± 0.11	37.04±0.18
2	5.66 ± 0.20	25.12 ± 0.20	47.26±0.22
3	10.00 ± 0.20	21.24 ± 0.21	52.38±0.25
4	10.80 ± 0.28	19.94 ± 0.22	45.45±0.25
5	11.26 ± 0.21	23.16 ± 0.16	52.08±0.18
6	12.5 ± 0.16	19.66 ± 0.20	35.23±0.23
7	5.50 ± 0.16	21.08 ± 0.16	42.30±0.22

Protein content values of around 20 % for diet pasta of low calorie content (based on literature review) were taken into account. All tests were within this range.

Cooking times in all tests were between 15 and 20 minutes, which are acceptable values, considering that pasta has high protein content in relation to common noodles.

The data obtained from the sensorial analysis are shown in Table 3.

Table 3. Average results provided by panellists during tests of different characteristics of pasta mixtures

Variable	Mixture 1	Mixture 2	Mixture 3	Mixture 4	Mixture 5	Mixture 6	Mixture 7
Colour	6.20 ± .24	9.12 ± .11	6.12 ± .35	7.06 ± .23	4.43 ± .27	6.25 ± .24	9.50 ± .16
Aroma	4.37 ± .35	2.06 ± .33	9.43 ± .08	9.18 ± .17	5.38 ± .25	3.45 ± .16	1.25 ± .22
Flavour	8.09 ± .17	2.28 ± .27	9.50 ± .09	9.80 ± .19	7.61 ± .28	5.33 ± .20	1.44 ± .33
Consistency	7.16 ± .20	6.34 ± .11	5.37 ± .28	5.64 ± .22	7.13 ± .16	7.45 ± .33	6.04 ± .25

Scales: colour (0=unpleasant; 10=pleasant); aroma (0=pleasant; 10=unpleasant); flavour (0=pleasant; 10=unpleasant); consistency ("al dente"=6; range of acceptance=5-7)

In the case of pasta, the desired colour is a light yellow provided by semolina, which can be increased in the mixtures with the addition of corn, gluten and bran flour. Soybean flour apparently has a whitening effect due to the enzymes that originate from the production of peroxide acting on the carotenoids, a fact evidenced in mixture 4, in spite of having high semolina content [2].

As regards aroma and flavour (see Fig. 1), panellists showed a marked rejection of mixtures 3 and 4, which contain soybean flour, because of their bean taste; while in the other mixtures a taste of cereal was identified. Mixtures 1 and 5 were qualified as unpleasant because of an excessive bran taste.

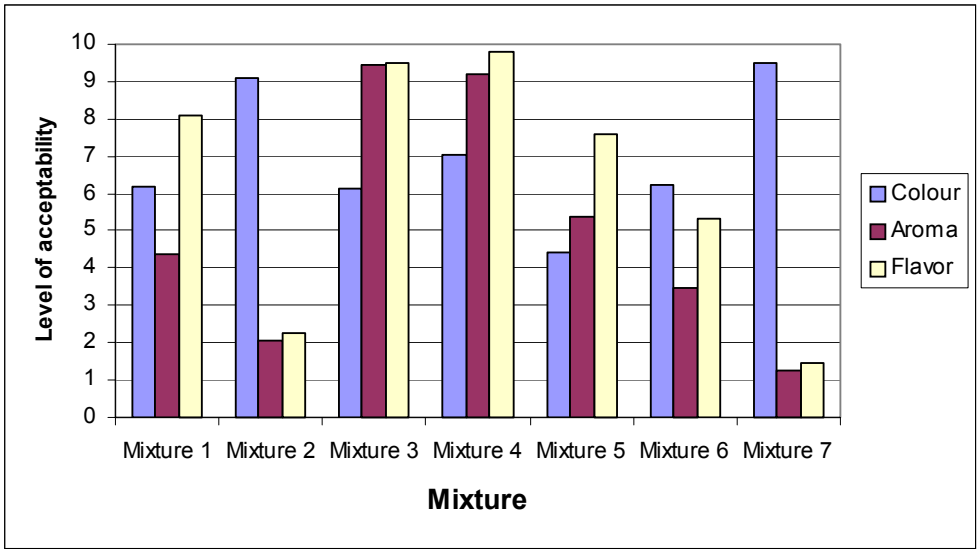

Fig. 1. Colour, aroma and flavour results provided by the panellists during tests of different characteristics of pasta mixtures
Scales: colour (0=unpleasant; 10=pleasant);
aroma (0=pleasant; 10=unpleasant); flavour (0=pleasant; 10=unpleasant)

As regards consistency (see Fig. 2), data analysis showed mixtures 2 and 7 as the most acceptable ones. Consistency in cooked pasta is the main factor of acceptance, and in the studied cases, semolina and gluten additions gave greater consistency.

Mixture 6 has two parameters (aroma and flavour) pleasant and colour similar to that of mixtures 1 and 3; but the consistency value is not good enough to make it acceptable.

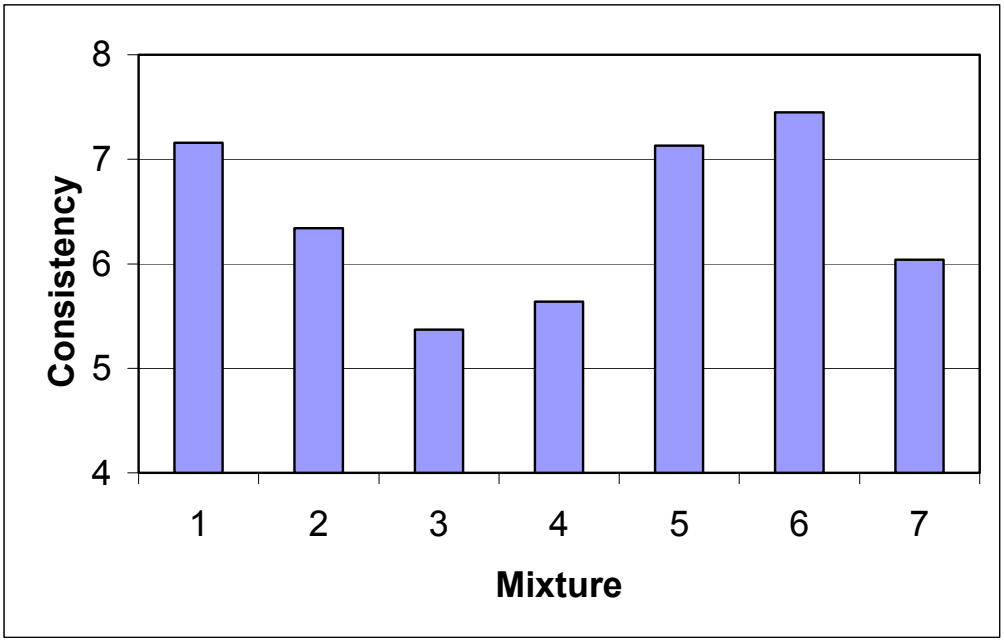

Fig. 2. Consistency results provided by the panellists during tests of different characteristics of pasta mixtures
Scales: ("al dente"=6; range of acceptance=5-7)

4. CONCLUTIONS

Pasta, acceptable as a diet food, can be obtained with the proposed mixtures of wheat flour, semolina and gluten, which are within the range of protein values recommended in the literature.

The most advisable mixtures according to the sensorial evaluations carried out are as follows:

- 85 % wheat flour and 15 % gluten
- 55 % wheat flour, 35 % semolina and 15 % gluten, although we consider that this mixture should be complemented with a preference test.

The addition of soybean flour and bran were unpleasant for the panellists, although from a financial viewpoint, with future industrial production in mind, other proportions should be studied in order to attain their acceptance.

The determinations carried out should be complemented with a further study of fibre content, as well as with an evaluation of calories provided by each sample in order to ensure their qualification as diet pasta.

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