

Elaboration of an Instant Beverage Amaranth Seeds (*Amaranthus cruentus*) and its potential use in the human diet

N. Arcila and Y. Mendoza

Universidad Nacional Experimental Simón Rodríguez. Núcleo Canoabo.

Ingeniería de Alimentos. Carretera Urama – Canoabo. Canoabo – Municipio Bejuma. Estado Carabobo – Venezuela.

Abstract

The purpose of this article is based on the obtaining of an instant beverage from mixing amaranth seed flour with rice flour, corn flour, milk whey and powder milk; which has a minimum of sixteen percent (16%) of protein and 350 Kcal. Five formulations were established having between 20% and 40% of amaranth seed content. Subsequently, formulations were processed on spray dryer until instant beverage characteristics are obtained. The product was then evaluated with a non trained panel using the hedonic scale sensorial evaluation results. It was found that the formulation with greater acceptance (with 95% of confidence) was "C", containing 30% of amaranth flour, 30% of powder milk, 5% of rice flour and 5% of corn flour (Wilconxon, $P < 0.05$). It is concluded that amaranth seeds are a nutritional alternative for the elaboration of highly protean instant beverage.

Key words: *Amaranthus cruentus*, amaranth, cereals, instant beverage.

Introduction

Cereals are for most undeveloped countries the main source of alimentation. However, even though cereals have adequate values they do not provide the optimum requirements of amino acids. Among the strategies used by some researchers to improve the nutritional quality of these foods is the protean enrichment with non conventional

sources (1). Species of the *Amaranthus* genus have been described as non traditional protean sources, pointing from 12 to 16% superior values than wheat (10%), corn (10%) and rice (7%) (29,3). Another nutritional advantage that these species represent is the composition of amino acids, which have 5.6 g/16 g of nitrogen for lysine and 1.0 g/16 g of

nitrogen for tryptophan (1, 3), superior values than those established by FAO (19) as a reference pattern for amino acids.

Different research have been done due to the nutritional quality of seeds for enriching corn flours in the confection of "arepas" (25), elaboration of nougats, protean cookies, pasta and

bread (26). The objective of this research was to obtain an instant beverage of amaranth seeds (*Amaranthus cruentus*), rice flour and corn flour, milk whey in powder and powder milk, with a minimum of 16% of proteins and 350 Kcal and also to obtain the acceptance of this product.

Materials and methods

Formulation of instant drinks.

The criteria assumed to establish the formulation of this product was based on the mentioned on the Official journal of the Republic of Venezuela N° 29802, a ruling about products for infants with vegetal ingredients cited by Guerra *et al.*, (5), which indicates that products must not have less than 16% of proteins and 350 Kcal.

Initially, a series of theoretical formulations were done, that presented all combination possibilities of the different raw matter, through this, those formulations that fulfilled to what the Official journal of the Republic of Venezuela established were chosen N° 29802, regarding proteins values (superiors to 16%) and calories (higher than 350 Kcal/100 g).

Five formulas were done, with an amaranth content between 20 to 40%, all fulfilled with the 16% of proteins established on the Official Journal N° 29802 (table 1).

Raw matter

The ingredients used: *Amaranthus cruentus* seeds, rice in

grains, corn flour, powder milk, whey milk in powder and vanilla flavoring, which were acquired on the local market of products with registered brands. *Amaranthus cruentus* seeds were supplied by the INIA- Acarigua of the K 119 non certified variety.

Physic-chemical and microbiologic characterization of the raw matter

Raw matter was physic-chemical and microbiologically characterized according to the Venezuelan norms COVENIN. The evaluated parameters were humidity (5, 6), protein (7, 8), fats (11), carbohydrates (10) and ashes (11), mesophyll aerobes (12) funguses and yeast (13) *Salmonella* sp. (14), *Escherichia coli* (15), *Staphilococcus aureus* (16) and *Bacillus cereus* (17).

Granulometry of the used flours

Regarding the granulometry test done, a set of three sieves with an opening were used of 600, 425 and 100 mm (microns), respectively. When 100% of the flour passed through the sieve, 425 mm was considered in adequate conditions of granulometry, in this way the granulometry

conditions gathered to use the atomization dryer.

Elaboration of pre-cooked flours

For the elaboration of the product two processes were applied: one for the preparation of the amaranth and rice pre-cooked flours, and another for the obtaining of an instant drink according to what it is showed in figures 1 and 2 respectively.

Since one of the conditions was that the product be instant, the dehydration was done with an atomization dryer brand ANHYDRO-model 1.

Evaluation of the functional properties of products

The functional properties of products were evaluated, measuring the solubility indexes (ISA) and the absorption of water (IAA) using the Anderson *et al.*, method (2).

Physic-chemical and microbiological evaluation

To obtain products were determined: humidity (5, 6), proteins (7, 8), fats (9), carbohydrates (10) and ashes (11) (attending the procedures established by the Venezuelan Committee of Industrial Norms COVENIN).

The microbiologic determinations done to the products were mesophyll aerobes (12) funguses and yeasts (13), *Salmonella* sp. (14),

Escherichia coli (15), *Bacillus cereus* (17) and *Staphilococcus aureus* (16) (positive coagulase) (attending the procedures established by the Venezuelan Committee of Industrial Norms COVENIN).

Caloric percentage of the elaborated formulations

The caloric determination was done on an adiabatic calorimeter brand PARR, X-3 model.

Sensorial evaluation

In order to do a sensorial evaluation, formulations in water at 20% were reconstructed by the instant condition, formulas presented were easily diluted, it only required a slight mix with the hand, the water was at an environmental temperature and formulas were presented at the same temperature. A test like the hedonic scale was carried out employing and non trained sample taster panel of 30 persons, with the aim of evaluating the acceptance.

Statistical analysis

The results of the sensorial tests were evaluated through the non parametric Wilcoxon test ($P < 0.05$) (20).

In figures 1 and 2, processes corresponding to the elaboration of amaranth and rice flour are indicated as well as the elaboration of the instant drink.

Results and discussion

The proportion of ingredients per formula is presented on table 1.

In table 2 it is showed the physic-chemical characterization of

the raw matter, these values are very similar to those presented in the literature, Wood *et al.*, (28).

In table 3 it is showed the results

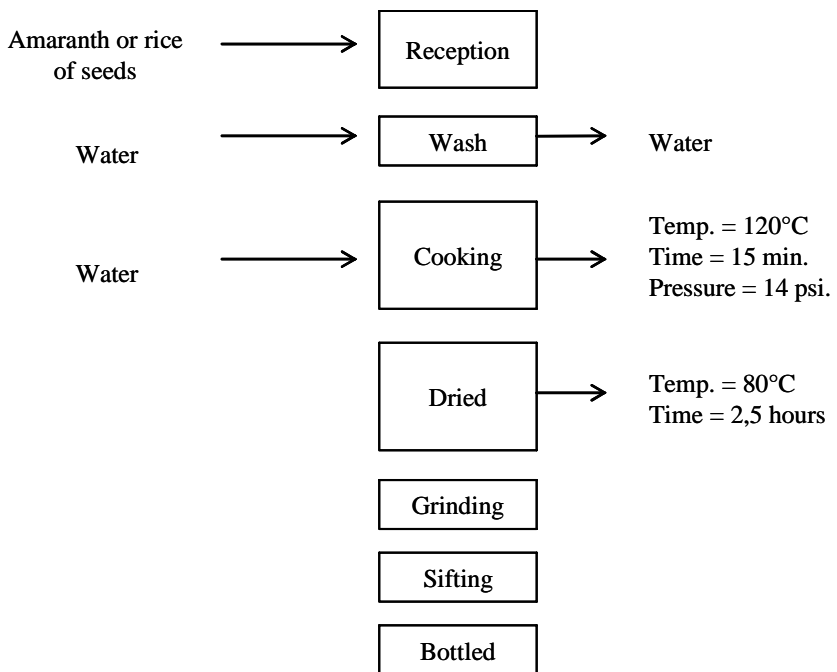


Figure 1. Flow chart of the Process for the elaboration of the flours precocidas of amaranto and rice.

of the granulometry evaluation of the raw matter.

It has been indicated that from the granulometry depends that the products could suspends in a lower or higher grade, and with granulometries higher than 425 mm, the remnant sediment doing the test of the processes products will be minimum and the product will be uniformly suspended. With the experimented granulometry, the product does not have any inconvenient to be used as an instant drink, Imeri *et al.*, (22).

Percentages and the protean-caloric nutritional provision of each of the components of samples are

presented in table 4. All formulas fulfill with the requirements of a food with a highly nutritional value (with 16% of proteins and 350 Kcal/100 g of the food) (21).

The evaluation results of the functional properties of the finished products are presented in table 5. The absorption index of water increases at the time that increases the amaranth percentage, a similar situation than the observed by Pacheco and Portillo (25). On the contrary, the solubility index reduced when the amaranth content in the formulation increased. This situation might be related to the exposed by Martinez *et al.*, (23), who indicate that the low solubility of the

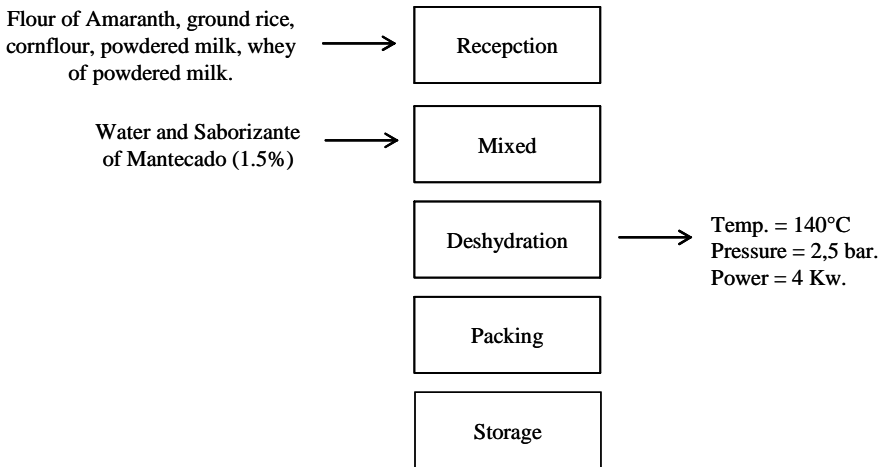


Figure 2. Flow chart of the process for the obtaining of an instant food.

amaranth grain is due to the high content of the protean fraction of glutelins, an outstanding characteristic in this type of fraction.

The results of the proximal and caloric analysis of the finished product are showed in table 6. The different formulas submitted to test, have differences in relation to the calories and proteins content. Formulations than contain a higher proportion of powder milk have superior values of

fats. All formulas have protean and caloric values, according to the requested by the Venezuelan Official Journal N° 29802 for food with a high nutritional value and are in agreement to the exposed by Tarazona and Hernández (27).

The microbiologic characterization is presented in table 7, where values are observed in relation to the demanded by the respective COVENIN norm (18).

Table 1. Composition of the established formulas.

Formula	Composition (%)				
	Milk whey	Powdered milk	Rice	Corn	Amaranth seeds
A	25	25	-	10	40
B	30	25	5	5	35
C	30	30	5	5	30
D	30	30	10	5	25
E	15	40	15	10	20

Table 2. Physic-chemical characterization of raw matter (g./100 g).

Parameter	Constituent				
	Milk whey	Powdered milk	Rice	Corn	Amaranth seeds
Humedad	3.15 ± 0.16	3.20 ± 0.08	10.20 ± 0.15	9.99 ± 0.09	9.80 ± 0.12
Proteína	12.88 ± 0.08	25.51 ± 0.05	7.35 ± 0.05	8.10 ± 0.05	16.65 ± 0.06
Grasa	0.50 ± 0.03	26.50 ± 0.12	0.44 ± 0.02	1.65 ± 0.05	7.45 ± 0.09
Carbohidratos	76.26	36.29	81.36	79.45	62.00
Cenizas	7.21 ± 0.05	8.5 ± 0.07	0.65 ± 0.03	0.90 ± 0.03	3.50 ± 0.05

In table 8, average values of the sensorial evaluation are presented. Regarding the smell, it can be seen that there are not significant differences among formulas A, C and D. This situation is also presented for smell and color. According to the ge-

neral appearance attribute, it can be seen differences among all formulas. Formula C was selected by the tested preference in its acceptance compare to the rest formulas followed by D, A, B and E.

Table 3. Granulometry of raw matter.

Formula	Mesh 600 µm		Mesh 425 µm		Mesh 106 µm	
	%	%	%	%	%	%
	Retained	Through	Retained	Through	Retained	Through
Amaranth	0	100	0	100	80	20
Rice	0	100	0	100	81	19
Corn	0	100	2	98	98	2
Milk	0	100	0	100	80	20
Whey	0	100	0	100	90	10

Table 4. Theoretical values of the contribute caloric-protean of the different ingredients utilized in them you formulate practiced.

Composition	Milk whey			Powdered milk			Rice flour			Corn flour			Amaranth flour			Total Protein	Total calories
	%	P	C	%	P	C	%	P	C	%	P	C	%	P	C		
A	25	3.22	88.63	25	6.30	120.50	-	-	-	10	0.81	36.46	40	6.66	159.5	16.99	405.09
B	30	3.86	106.35	25	6.30	120.50	5	0.36	10.51	5	0.41	10.23	35	5.83	139.5	16.76	387.09
C	30	3.86	106.35	30	7.65	144.60	5	0.36	10.51	5	0.41	10.23	30	4.99	119.5	17.27	391.19
D	30	3.86	106.35	30	7.65	144.60	10	0.73	37.02	5	0.41	10.23	25	4.16	99.7	16.81	397.90
E	15	1.93	53.17	40	10.20	192.90	15	1.10	55.53	10	0.81	36.46	20	3.33	79.76	17.37	417.82

P= Potein

C= Calories

Table 5. Functional properties of the finished product.

Formula	I.A.A	I.S.A.
A	1.87	8.79
B	1.80	9.10
C	1.78	9.20
D	1.76	9.40
E	1.75	9.50

I.A.A: Absorption index of water, g of gel/ 1 g of the sample.

I.S.A: Solubility index in the water, %.

Table 6. Chemical characterization of the finished product (g/100 g).

Parameter	Formulas				
	A	B	C	D	E
Humidity	3.10	3.08	3.15	3.12	3.18
Protein (N x 6.25)	16.90	16.72	17.15	16.61	17.10
Fats	9.91	9.49	10.44	10.08	12.41
Carbohydrates (*)	65.29	65.81	64.20	65.09	62.46
Ashes	4.80	4.90	5.05	5.10	4.85
Calories Kcal/100 g	428.10	427.10	429.8	426.4	428.15

(*) per difference

Table 7. Microbiological characterization of the finished treatment.

Characteristic	Formulas				
	A	B	C	D	E
Funguses ufc/g	15	10	20	20	10
Yeasts ufc/g	6	2	10	5	2
Mesophyll aerobes ufc/g	10	5	10	10	15
<i>Salmonella</i> 25 g	0	0	0	0	0
Total coliforms NMP/g	< 3	< 3	< 3	< 3	< 3
<i>Escherichia coli</i> ufc/g	-	-	-	-	-
<i>Bacillus cereus</i> ufc/g	<1x10 ³	<1x10 ³	<1x10 ³	<1x10 ³	<1x10 ³
<i>Staphilococcus aureus</i> ufc/g	<1x10 ³	<1x10 ³	<1x10 ³	<1x10 ³	<1x10 ³

- Non detected values

Table 8. Averaged results of the sensorial evaluation.

Formula	Characteristics				
	Smell	Taste	Color	General appearance	Order
A	7.27 ^a	6.60 ^a	6.70 ^a	6.76 ^{bc}	3
B	6.77 ^b	6.63 ^a	7.00 ^a	6.66 ^c	4
C	7.50 ^a	7.43 ^a	7.17 ^a	7.10 ^{ab}	1
D	7.10 ^a	6.70 ^a	6.86 ^a	7.03 ^a	2
E	6.80 ^{ab}	5.40 ^b	6.83 ^a	6.43 ^c	5

- a, b y c= Same letters in each column (organoleptic characteristic) indicate that there is not significant differences ($P < 0.05$).

Conclusions

All the essayed formulas have a high nutritional value.

The mostly accepted formula on the sensorial evaluation was formula C.

An instant drink of amaranth seeds was obtained with a high

protean value (superior to 16% of proteins), and of great acceptance of the tasters, which allows to indicate that this is a product with good quality.

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