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Research Article

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Acrylamide in Algarrobine and the Recommendation of Daily Intake in the Population of Piura-Peru

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Summary

Objective: *Quantify the recommended daily intake of algarrobine with acrylamide in the population of Piura-Peru.*

Methods: *The raw material carob* ***(Prosopis pallida)****, was cut, in a proportion 1 kg of locust bean chopped with 4 liters of water (1: 4), placed in a pot type perol on direct fire, after extracting the sugars from the carob, it is filtered, to then concentrate the sugars at a temperature of 103 to 105ºC. Samples of different soluble solids were analyzed in the algarrobin. To quantify acrylamide was performed by ion chromatography and mass spectrophotometry (LC-MS). To determine the amount of acrylamide consumption in the algarrobine, the per capita consumption of algarrobine (surveys) was determined.*

Results: *One kilogram of carob was obtained 171.4 ml of algarrobin, with a density of 1.4 g / ml, a pH: 4.796, 4.26, 5.02 and 5.27 respectively, with a content of soluble solids of 77.07, 81.3, 74.98 and 82.6% respectively and a per-capita consumption of algarrobin of 0.17 lt / year / person. The content of acrylamide in the algarrobin was different in each sample: 303, 250, 83, 25 ug / kg respectively.*

Conclusions: *The lower the presence of acrylamide in algarrobine, the greater the consumption of algarrobine.*

Keywords: Acrylamide, Algarrobine, Soluble Solids, Ingestion.

Introduction

In Peru, the state agency INDECOPI-INACAL (National Institute of quality), in the technical standard of algarrobina 2009.600.2002, does not indicate permissible limits of the amount of acrylamide that algarrobin must have, nor does it indicate (during the commercialization), on the packaging label, its process technique. The algarrobine is the concentration of the sugars of the carob fruit (expressed in soluble solids) by the effect of the temperature around 103 to 105ºC, either to firewood or to gas as an energy source, the exposure time in the concentration is the critical point for the appearance of acrylamide, the solids have direct contact with the walls of the deposit burning part of the sugars, contributing to the bitter taste, for it is very important the generation of the movement with the pallet, in order to avoid burning too many sugars, as it could increase the content of acrylamide [1]. According to Mogues, it indicates that the caramelization or pyrolysis of monosaccharide sugars occurs when they are heated above their melting temperature, resulting in the appearance of enolization, dehydration and fragmentación reactions, which cause the formation of furanic derivatives which, by polymerization, form dark macromolecular pigments. If it is a disaccharide there must be a previous hydrolysis [2]. According to Ludeña, it indicates that with the reading of the refractometer, the soluble solids in the algarrobina, possibly include also the ashes, the soluble tannins, the cyclites, and not necessarily total sugars since some part underwent pyrolysis. This can also be verified with the bitterness and black color of a carob with a high concentration of soluble solids. Hence, the reading of soluble solids is better than the expression of brix degrees, in this case.

In the market there are samples of algarrobine since, 70, 74, 80% of soluble solids, its low water activity contributes to a prolonged period of useful life, with respect to the microbial activity. In Peru there are few research works regarding the content of acrylamide in food, hence the population can not be informed of the regulation of toxic components; On the other hand, this will help the carob producers to improve their processes, through the parameters of exposure time and adequate temperature and process techniques, in order to obtain a safe product.

The Joint FAO / WHO Expert Committee on Food Additives (JECFA) analyzed the presence of acrylamide in data from 24 countries and national dietary intake data from 17 countries [3]. The committee identified an average intake of acrylamide of 1µg / kg of body weight per day, for the general population, and 4µg / kg of body weight per day for large consumers, based on estimates of national intake between 0.3 and 2.0 µg / kg of body weight per day for the average consumer and 0.6 to 5.1 µg / kg of body weight per day for large consumers (90th to 99th percentile), according to FAO / WHO (2008).

Methods

Four samples of algarrobine were obtained from the Piura model market and from supermarkets. To quantify acrylamide was performed by ion chromatography and mass spectrophotometry (LC-MS) and to quantify the content of HMF the 4 samples were subjected by liquid chromatography (LC-DAD). To determine the amount of acrylamide consumption in the algarrobine, the per capita consumption of algarrobine (surveys) was determined.

Equation to determine the consumption of acrylamide in algarrobine (CAA)

CAA = Amount of acrylamide in algarrobin (ug/kg) * Kg consumption of algarrobin / kg person-day

-To determine the population surveyed

n = N * Z ^ 2 * p * q / a * (N-1) + Z ^ 2 * p * q

N = Population

Z = Statistic, 1.96

p and q = Statistic, 0.5

a = error, 5%.

Recommended daily intake (IDR)

The determination of the Maximum Theoretical Daily Ingestion (IDMT) is obtained by multiplying the per capita daily consumption of each food or group of foods by the legislated use doses (DU) of the additives or maximum admissible levels (ML); the IDMT constitutes a great overestimation, since to calculate it it is assumed that all the foods in which the additive is authorized contain it and in a concentration equal to the ML, that the ingestion of the additive is daily throughout life, that all foods in which the additive is used are consumed totally without waste and that the concentration the additive in the food is not reduced by processing or storage. If the IDMT does not exceed the acceptable daily intake without toxicological risks (ADI) there is no cause for concern, but if it exceeds it, the effective daily intake (EOD) must be calculated, which entails, among other costly operations, chemical content analysis. of the additive in foods.

IDR = ADI of consumption / amount of acrylamide in algarrobin (mg), Table 3.

Results and Discussion

Table 1: Analysis of carob pulp

Components	Quantities
Humedad (%)	12.76 (b.h)
Ashes (%)	3.45 (b.h)
Solids soluble (ºBrix)	59
pH	5.29
Drymatter (%)	87.24

In Table 1, the analysis performed on the carob pulp is shown, indicating a content of 59% soluble solids, showing the content of sugars and other compounds, within their content of soluble solids and a content of 87.24% of matter dry, according to Clua, mentions that carob is an energy food, with a high content of sugars, which contributes 10% of protein to the diet, as well as the minerals: calcium, iron and phosphorus [4]. These minerals are better absorbed when combined with foods that contain ascorbic acid (vitamin C) and citric acid, as is the case with orange and grapefruit juices. Also the carob is a legume with a high content of sugars (20-50%), fiber and tannins and low in protein and fat, its main components are: the pulp that represents 90% of the fruit, highlighting its high content in sugars such as sucrose, glucose and fructose and in tannins and the seed that represents the remaining 10%. On the other hand, Eizaguirre, mentions that carob contains less fat: 2%, 10% protein, 40% natural sugars and does not contain gluten so it is suitable for celiac [5]. Also noteworthy in its composition is 13% soluble fibers (pectin and lignin) that help to carry out digestion and the benefits for the intestinal flora increase the amount of lactobacilli. Contains tannins included in the group of polyphenols, with antioxidant, antirheumatic and anti-inflammatory properties and beneficial for the heart and kidneys. It also contains zinc, manganese, iron, copper, sodium, magnesium, phosphorus, calcium and potassium in important quantities.

The yield of algarrobin in relation to the matter: Yield (ml in carob/kg of carob) is 17.14% This means that 1 kilogram of carob can be approximately 171.4 ml of carob, this data is very important to obtain costs and profits projected To obtain a bottle of algarrobina (760 ml) 4.3 kg of carob raw material is needed.

Table 2: Acrylamidecontent in algarrobin

Muestras de algarrobina	Acrilamida (AA) ug/Kg	pH	SS %
M1	303	4.79	77.07
M2	250	4.26	81.3
M3	83	5.02	74.98
M4	25	5.27	82.6

In Table 2, it is observed that the samples have different contents of soluble solids (SS), different pH and different acrylamide contents; this can be due to the turbulence technique generated with the pallet by the staff, which must be constant in order to avoid burning the sugars each time the concentration increases. According to Mogues, it indicates that the caramelization or pyrolysis of monosaccharide sugars occurs when they are heated above their melting temperature, resulting in the appearance of enolization, dehydration and fragmentation reactions, which cause the formation of furanic derivatives which, by polymerization, form dark macromolecular pigments [3]. If it is a disaccharide there must be a previous hydrolysis. The concentration increases with the reading of the refractometer by increasing soluble solids, possibly the ashes, the soluble tannins, the cyclites, on the other hand the part of the soluble solids that it is very probable that the rain of sugars will be replaced by the ashes, being achieved burn the sugars much more but you have more care, this is where the operator must move, shaking with the palette the carob with greater dedication, lowering a bit the direct fire. Possibly the contact of the algarrobina with the content of the deposit (the part that gives to the direct fire), affects a lot, accelerating the unfolding of the sugars, to greater exhibition greater presence of acrylamide.

Possibly the low content of acrylamide in Table 2, these components formed by high exposure and temperature may be unfolding to other components a lot or little toxic, so it needs further study to check

Population surveyed

The population of the Piura district is 279 927 people (according to 2010 projections of INEI-Peru). To determine the amount of population surveyed: The following formula was used:

n = N * Z ^ 2 * p * q / a * (N-1) + Z ^ 2 * p * q
Replacing:
n = 400
The number of respondents was obtained for the total population of the district of Piura of 400 people, representing 0.14% of the total population of the city of Piura, in the survey a distinction was made between ages but not Social class.

400 young people and adults of both sexes were surveyed pedestrians, young people and adults without class differentiation (18 to 62 years of age) from the City of Piura-Peru.

Recommended daily intake of acrylamide (IDR)

Considering an ADI of 0.006 mg, for acrylamide (maximum value, mentioned by JECFA) and a daily consumption of 5 ml of algarrobin (7 g), considering only consumers of medium high carob.

Table 3: Recommended daily intake for consumption of algarrobine with presence of acrylamide

Maximumdailyintake Recommended						
Male		Muestra (M)	M1	M2	M3	M4
IDA mg/kg.pc.dia 0,006		Sample, g	7	7	7	7
		mg/kg (AA)	0,303	0,25	0,083	0,025
		mg	0,002121	0,00175	0,000581	0,000175
Age	weight	IDA				
years	kg	mg				
18-20	61,5	0,369	173,97	210,86	635,11	2108,57
20-22	62,7	0,3762	177,37	214,97	647,50	2149,71
22-34	63,7	0,3822	180,20	218,40	657,83	2184,00
34-36	64,4	0,3864	182,18	220,80	665,06	2208,00
36-38	65,8	0,3948	186,14	225,60	679,52	2256,00
30-40	67,9	0,4074	192,08	232,80	701,20	2328,00
40-42	68,7	0,4122	194,34	235,54	709,47	2355,43
42-44	71,1	0,4266	201,13	243,77	734,25	2437,71
44-46	71,3	0,4278	201,70	244,46	736,32	2444,57
46-48	72,5	0,435	205,09	248,57	748,71	2485,71
48-50	78,8	0,4728	222,91	270,17	813,77	2701,71
52-54	79,3	0,4758	224,33	271,89	818,93	2718,86

Table 3, indicates that the greater the weight of the person, the greater the ability to consume algarrobine with the presence of acrylamide, without incurring toxicological risks throughout his life. A 30-year-old person with 63.7 kg of weight can consume 180 servings of 7 grams each serving, at maximum daily recommended without toxicological risks, 218 servings with an acrylamide content in algarrobin of 0.00175 mg, at 7 g of algarrobine consumption daily. In larger portions of consumption, less presence of the toxicological substance corresponds to health.

Conclusions

- The greater the presence of acrylamide in algarrobin, the lower the dose of consumption, in the person.
- The content of acrylamide in the algarrobin consumption in Piura, does not exceed the values of acceptable daily intake, because the per capita consumption of algarrobine is low and infrequent
- There are samples of algarrobin that indicated 0 ug / kg of acrylamide, may be due to the actual acrylamide content (optimal process technique) or because said component disappeared, becoming other components not yet studied [6-10].

Recommendations

- INDECOPI-INACAL, should conduct studies on the various processed foods consumed in Peru, with respect to acrylamide and others formed by high temperature and excess exposure .
- On the content of acrylamide should be included in the NTP 209.600 (2002).
- Studies should be carried out on the content of asparagine in the carob tree and see its effects of this amino acid by thermal treatment.
- The Piurana community should be informed about toxicological substances in food consumption and their possible effect on health.
- Establish a monitoring to check the effectiveness of this result (acrylamide), some high-consumption processed foods (meat grills, hamburgers, reused oils, brown sugar, reheated bee honeys, chifles, blancmange, nougat, roasted peanuts, etc.), through the frequency of consumption and size of the ration of this type of food, in companies in order to improve their processes.

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