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Abstract

In Chile, rice industry generates important volumes of by-products of low commercial value. Many of such by-products present nutritional properties similar to those of whole grains and, therefore, the main cause of their little valuation would be the form that conditions their destination. For such a reason, extrusion would be the most appropriate technology to revalue processing rice by-products upon making possible to obtain attractive products with diverse forms, sizes, flavors and colors.

The purpose of this study was to determine the microbiological characteristic of reconfigured rice by extrusion, flavored with garlic, garlic plus fiber, barbecued steak, barbecued steak plus fiber, onion and onion plus fiber.

The results show that according to the microbiological margins established by the Food Sanitary Regulations of Chile (RSA) with those obtained by the reconfigured rice samples, these last do not present danger to the human being.

Introduction

Rice is the main product of the diet of many countries of the world. In terms of world production, it is the second more consumed cereal after wheat.

Rice production in Chile, comes from 25,121 hectares annually, with a total production of 130,377 tons, that concentrate fundamentally in the VII and VIII Regions (ODEPA, 2010/ 11 season). The area of rice has generally tended to reduce fluctuating its relative participation, around 3,5%. This rises to 15% in the case of the VII Region.

In that context, the increase in demand for special rice types (like those elaborated starting from extrusion), the interest of private sector as well as of government in increase the profitability of the production, conform the conditions to incentivize the elaboration of a product that complies with high standard of quality. This work is part of an investigation that studies to obtain, reconfigured rice by extrusion of rice by-products

The aim of this work is to know the microbiological characteristic of the several types of reconfigured rice obtained by extrusion process (innovative products) as a way of evaluating their sanitary and sensorial quality.

Methods

Raw Material

Six groups of reconfigured rice were used. Each group was formulated with a flavor (1.2% garlic and garlic plus fiber, 2.5%, barbecued steak and barbecued steak plus fiber, 1.2% onion and onion plus fiber) respectively. The concentration of fiber used in each formulation was 4.0%.

Microbiological analysis:

Three random samples of each of the selected treatments kept in storage at room temperature and analyzed at 0 and 15 days. Three dilutions in duplicate to each one of them were made and the following analytical methods were applied: *Bacillus cereus*, AOAC, 1995; Aerobic Mesophylles Count (AMC), AOAC Official Method 990.12.; Yeasts and Molds AOAC. Official Method 997.02.

Statistical analysis:

Data was analyzed statistically for Mean and Standard deviation by using the mini-tab software. Mean values of different microbial parameters were calculated and the data was presented in the form of tables and figures.

Results and Discussion

When we compared the microbiological samples (Table 1) stored by 15 day with day zero, was observed, that the microbial loads of alls microorganisms assayed do not increase in significant amounts. This suggest that reconfigured rice is a highly stable product through time, because it possess a low water activity of around 0.70.

B. cereus possesses an aw level of 0.95, being unable to grow in with low [aw]. For the other hand, the yeasts and molds are able to grow in lower water activities values (< 0.75), but need other factors to grow, like for example, temperature of around 25º C and available oxygen. After 15 days, not significant change in the microbial load was observed (Table 1) in comparison to the determined growth for the zero day. For the other hand, for garlic plus fiber not was observed

growth of *B. cereus*. This result is similar to that observed by Durairaj et al. (2009) who reported that Garlic (*Allium sativum* L.) exhibit a broad antibiotic activity against both gram negative and gram positive bacteria including species Bacillus.

For Yeast and molds (Table 1) no differences was observed in the growth between the values at zero days and stored at 15 days. This characteristic could be attributed to the rice was well managed at the raw material level and that the extrusion process and its packing was efficient.

Its possible to mention that the results obtained from the microbiological analysis of reconfigured rice have been contrasted, in first instance, with those established by the Food Sanitary Regulations of Chile (RSA), XV Title, V paragraph, "of other farinaceous products" for AMC m= 10^4; and "of noodles and padded dried up pastas" for mushrooms= 10^2.

The letter "m" is defined as the value of the microbiological parameter for which, or below which, the food doesn't represent a risk for health. It have been proceeded so, since in the RSA reconfigured rice is not specified as such. It is important also to point out that the RSA doesn't contemplate the of *B. cereus* analysis for these products.

Statistical analysis of variance (Table 2) showed that no difference was observed between the carried out determinations between day 15 respect to day 0 of storage. This suggests the reconfigured rice stay microbiologically stable since there is not significant increase of the microbial load (*B. cereus*, AMC and Yeast and molds) during this period. Also, that all the variances of the 6 samples, so much as for the *B. cereus*, RAM and Yeast and molds analysis are lower than the F table value given by the same program

Conclusion(s)

Upon confronting the microbiological limits established in the RSA, with those obtained in the reconfigured rice it can be observed that the results of these last do not present risks for the human being, suggesting that the presence of Bacillus cereus in reconfigured rice doesn't present toxic risk for health, reason for which the RSA doesn't consider it.

For the other hand, the low count levels of yeast and molds suggest a low probability of potential problems of contamination during the storage at room temperature, and don't influence the organoleptic characteristic of the product, during storage.

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Illustrations

Illustration 1

Table 1. Microbiological analysis (log cfu/ml) of rice samples at zero time and 15 days .

	B. cereus		AMC		Yeast and molds	
	Time in storage (days)		Time in storage (days)		Time in storage (days)	
Rice Samples	0	15	0	15	0	15
barbecued steak	3.50 ± 1.27	3.50 ± 0.10	4.00 ± 0.13	4.00 ± 0.12	2.00 ± 0.00	2.00 ± 0.00
barbecued steak plus fiber	2.00 ± 0.00	2.00 ± 0.00	3.05 ± 0.09	3.10 ± 0.02	2.00 ± 0.00	2.00 ± 0.00
garlic	4.65 ± 0.00	4.78 ± 0.02	3.84 ± 0.01	3.85 ± 0.00	2.00 ± 0.00	2.00 ± 0.00
garlic plus fiber	n.f	n.f	2.96 ± 0.20	2.83 ± 0.03	2.00 ± 0.00	2.00 ± 0.00
onion	3.23 ± 1.07	3.48 ± 0.10	4.23 ± 0.11	4.23 ± 0.11	2.00 ± 0.00	2.00 ± 0.00
onion plus fiber	3.52 ± 0.00	3.61 ± 0.08	3.24 ± 0.09	3.22 ± 0.06	2.00 ± 0.00	2.00 ± 0.00

Results are showed as average ± standard deviation. nf: not found

Illustration 2

Table 2.Statistical analysis of variance of microbiological analysis.

Flavor	*B. cereus*	AMC	Yeast and molds
barbecued steak	59,815	122,072	0,001
barbecued steak plus fiber	0,687	0,0	0,001
Garlic	2.204,920	0,076	0,001
garlic plus fiber	93,462	1,907	0,001
Onion	83,085	0,0	0,0
Onion plus fiber	19.532	0,305	0,733

F value of table is 65535, then in any of the samples exist significant differences between the days of storage since the calculated F is lower than F of table