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MICROBIOLOGICAL QUALITY OF PLANTAIN SNACKS (*Musa* AAB CV. HORN) MADE IN THE SOUTH ZONE OF MARACAIBO LAKE, VENEZUELA

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ABSTRACT

Microorganisms play an important role in the development and preservation of food. Moreover, they are also involved in the breakdown of the same, causing economic losses and social problems associated with intestinal infections and/or food intoxication. The snacks are easy to handle, these products presented in individual portions, and that do not require additional preparation to satisfy the appetite in the short term. These foods are considered high risk, because in some countries are made the traditional way; that is to say, do not have health quality of microbiological control to ensure their safety. The objective was to determine the presence of microorganism indicators of hygienic conditions in plantain snack products made in the Corporation INVECA, C.A., located in Santa Barbara de Zulia, Colón municipality, Zulia state. By grown in depth, aerobic mesophilic bacteria, fungi, yeasts, and thermotolerant coliforms were determined by the most probable number (MPN). In the ten samples analyzed, indicators microorganisms were detected below the national limit accepted for other similar snacks. Finally, the plantain chips are considered unfit for human consumption, because they meet the requirements of microbiological criteria set out in the Technical Standard Health (NTS No. 591-MINSA/DIGESA-V-.01) for the group and subgroup of food that it belongs.

KEYWORDS: Snack, plantain, thermotolerant coliforms, aerobic mesophilic bacteria, molds and yeasts, microbiological quality of food.

CALIDAD MICROBIOLÓGICA DE LOS BOCADILLOS DE PLÁTANO (*Musa* AAB CV. HARTÓN) ELABORADOS EN LA ZONA SUR DEL LAGO DE MARACAIBO, VENEZUELA

RESUMEN

Los microorganismos juegan un papel importante en la elaboración y conservación de los alimentos. Por otra parte, éstos también intervienen en la descomposición de los mismos,

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ocasionando pérdidas económicas y problemas sociales asociados a las infecciones intestinales y/o a las intoxicaciones alimentarias. Los bocadillos son productos fáciles de manipular, presentados en porciones individuales, que no requieren preparación adicional y satisfacen el apetito a corto plazo. Éstos son considerados alimentos de alto riesgo, ya que en algunos países son elaborados de manera artesanal, es decir, no cuentan con un control de calidad sanitaria (microbiológica) que garantice su inocuidad. El objetivo del trabajo fue determinar la presencia de microorganismos indicadores de las condiciones higiénicas, en productos de bocadillos de plátanos elaborados en la Corporación INVECA, C.A, ubicada en Santa Bárbara de Zulia, municipio Colón, estado Zulia. Mediante siembra en profundidad, se determinaron aerobios mesófilos, hongos, levaduras y coliformes termotolerantes, mediante el número más probable (NMP). En las diez muestras analizadas se detectaron los microorganismos indicadores, por debajo del límite nacional aceptado para otros bocadillos similares. Finalmente, las hojuelas se consideran aptas para el consumo humano porque cumplen con la exigencias de los criterios microbiológicos establecidos en la Norma Técnica Sanitaria (NTS N° 591-MINSA/DIGESA-V-.01) para el grupo y subgrupo de alimentos al que pertenece.

PALABRAS CLAVE: bocadillo, plátano, coliformes termotolerantes, bacterias aerobios mesófilas, mohos y levaduras, calidad microbiológica de los alimentos.

INTRODUCTION

Plantain production in Venezuela is based solely on the Horn giant clone; although there are other clones less commercially exploited (1-3). In Venezuela, the main producing centers are concentrated in the fields near the area south of Lake Maracaibo (Zulia, Trujillo, Mérida and Táchira states), due to the existing ecological conditions, that make this region, contributing about 70% of national production (4-7). Production of plantain snacks is a profitable business, to forces companies

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to improve the quality of its products in its organoleptic characteristics (mainly taste), and characteristics of health and hygiene of the raw material, such as microbiological quality, to utilize their physic-chemical characteristics and sensory as: Brix (°Brix), diameter, length, color and flavor. Snack consumption in Venezuela is high (4.7 kg/person/year), putting the country in third place in Latin America, surpassed only by Brazil and Argentina. This is especially relevant in eating habits of children and adolescents, who are the biggest consumers of snack products. The intake of these foods increases the ingestion of calories. These snack foods are considered high risk because in some countries like Venezuela are made the traditional way, ie do not have a quality control to ensure their safety. Competition in the Venezuelan market, the growing consolidation of the snack industry, the demand for safety standards, stricter production processes and the widening of the spread of disease through of the food, have determined that a large number of food industries, consider the need to opt for plans that offer continuous improvement in both manufacturing and food processing, and subjecting their products to certain tests or studies designed to evaluate its safety by microbiological analysis and by physic-chemical analysis such as determining the percentage of defective product and its humidity in different parts of the process (8-10). The snacks are prized as foods high in sugar, salt and fat, which make them seen as harmful to health, because of their frequent consumption, replacing the traditional

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food. However, you can make nutritious snacks from fruit, vegetables, cereals, milk or other ingredients that are beneficial to health (11). Figure 1 shows the scheme of obtaining plantain snack (Iselitas) of the INVECA C.A Corporation, located in Santa Bárbara de Zulia, Colón municipality, Zulia state. This figure shows a flowchart, highlighting the various checkpoints for quality control. The plantain snacks in Venezuela do not have a law regulating their quality in the presence of pathogenic microorganisms or the hygienic quality. The objective was to evaluate the presence of indicator organisms of the hygienic conditions in products plantain snack (Iselitas) Corporation INVECA C.A. between February and July 2015.

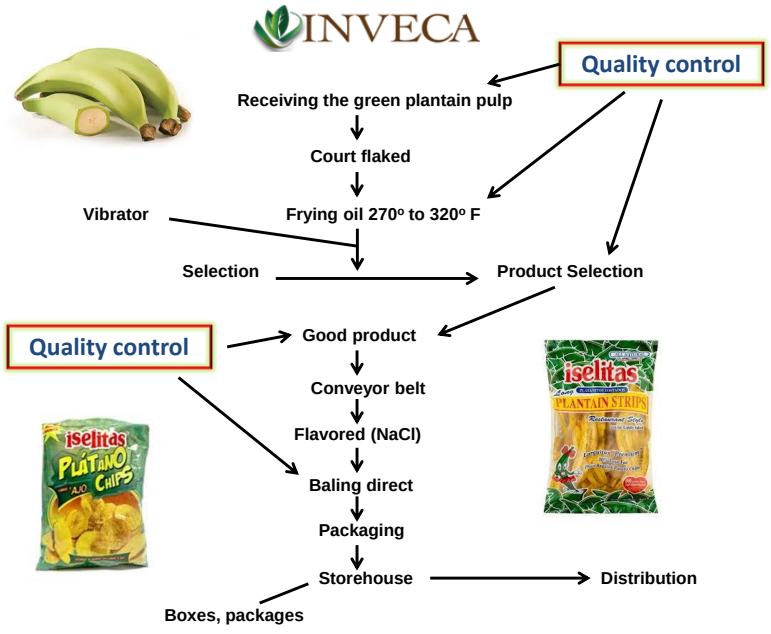

Figure 1. Flowchart for obtaining plantain snack (Iselitas) INVECA Corporation, C.A.

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MATERIALS AND METHODS

Type and design research. The design was descriptive and experimental (12).

Processing samples. Ten samples of plantain snack (Iselitas) were treated according to the criteria of COVENIN standard 1126-89 (coding and preparation of samples for microbiological analysis) (13). To processing, a given mix, consisted of a representative sample of plantain snack, homogeneous, later to be analyzed using serial dilutions ($1x10^{-1}$, $1x10^{-2}$, $1x10^{-3}$) and thus quantify the growth of mesophilic aerobic bacteria, thermotolerant coliforms, fungi and yeasts. After the incubation period (specified in the regulations), it was determined the number of colony forming units (CFU/mL). To this, 50 g of each sample, was ground in a blender to obtain smaller pieces, was added 50 mL of sterile peptone water. Then vigorously he stirred (50 times) at an angle of 45°.

Preparation of dilutions. 10 mL of each sample were transferred to a flask at a dilution ($1x10^{-1}$) using 90 mL of sterile 0.1% peptone water and stirred 25 times. From the first dilution, 5 mL were taken to add to a flask with 45 mL of peptone water ($1x10^{-2}$) and this way for dilution $1x10^{-3}$.

Determination of aerobic mesophilic bacteria. 1 mL of each of the dilutions (10^{-1}, 10^{-2}, 10^{-3}) was added to the respective plate: for planting, the COVENIN standard 902-87, was used (14). This analysis was done in triplicate to ten samples, and in three dilutions respectively. Immediately it was added

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15 to 20 mL of sterile nutrient agar medium, melted and tempered from 45 to 50 °C. To solidify the Nutrient Agar, allowed to cool and then the plates were incubated at 35 °C for 48 hours. Finally we proceeded to count the colonies at 24 hours and 48 hours.

Determination of fungi and yeasts. To make the determination of fungi and yeasts, the COVENIN standard 1337-1390, was used (15). One mL of each of the dilutions (10^{-1}, 10^{-2}, 10^{-3}) was added in triplicate in sterile Petri dishes. Then they were added 15 to 20 mL of molten medium (Potato Dextrose Agar) and temperate 45-50 °C. After cooling (to solidify the medium), they incubated for 7 days at a temperature of 25 °C, finally, the colony count, was performed every 24 hours for 7 days.

Determination of thermotolerant coliforms. To make the determination of thermotolerant coliform, the COVENIN standard 1104-1196 (16), was used. To this was added 1 mL of 10^{-1} dilution to each of the test tubes, this contained a Durham tube inverted, provided with sterile Tryptose-lauryl-sulfate broth, using six tubes per dilution. Then it was added 1 mL of 10^{-2} dilution to six tubes with Tryptose-lauryl-sulfate broth, and finally, was added 1 mL of 10^{-3} dilution to six tubes with Tryptose-lauryl-sulfate broth. The tubes were gently agitated and incubated at 35 °C ± 1 °C for 24 and 48 hours. The confirmatory test was not realized, because there was no presence of gas or turbidity corresponding to each test presumptive tube.

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RESULTS AND DISCUSSION

Table 1 shows the results obtained for thermotolerant coliforms, aerobic mesophilic bacteria, molds and yeasts, compared with the values of microbiological limit (m, acceptable or unacceptable) and unacceptable (limits M), according to the following source shows [N° 591-2008/MINSA, group V. cereal grains, legumes, chenopodiaceous and derivatives (flours and others), V-8: grain-based flakes (graminaceous, chenopodiaceous and leguminous) that require cooking] (17). Generally a valor equal to or less than "m" value represents an acceptable product and the higher values "m" indicates, the objectionable lots, in a sampling plan to 2 classes. The values of microbial counts greater than "M" is unacceptable, and for this reason, foods pose a risk to health. The aerobic mesophilic bacteria are the most common present in food, but in the samples analyzed the results are below the acceptable value indicating that the snack product of banana is suitable for consumption, without causing harmful damage, to consumer health, as this reflected a value of $5{,}55x10^4$ (Table 1). These samples are below "m" which is the boundary that separates the acceptable quality of rejectable; therefore contamination of the samples with these microorganisms is "acceptable" (18-24). According to García-Merino, 2012 (25) the low water activity and an acid pH, do not allow high growth of fungi and yeast, plus asepsis and frying process to which the flakes or chips undergo, inhibits microbial growth. These parameters indicate that the plantain chips are in

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optimal health quality, resulting $7{,}75x10^3$ (Table 1), a value that is in the allowed range, for the product is considered "acceptable".

Table 1. Microbiological quality of plantain snack (Iselitas), Corporation INVECA C.A.

Microbial agent	m	M	Result*
Aerobic mesophilic	10^4	10^6	$5{,}55 \times 10^4$
Molds and yeasts	10^3	10^4	$7{,}75 \times 10^3$
Thermotolerant coliforms	10^2	10^3	<3

***The result is the average value of three determinations for each of the ten samples processed; none exceeded the maximum permitted level. Microbiological limit m = acceptable or unacceptable and M = unacceptable limits for human consumption.**

The absence of thermotolerant coliforms in the ten samples indicates the sanitization that is used in Corporation INVECA CA, as they are employed good manufacturing practices for process development; equally contribute to ensuring the production of safe, healthy, and safe for human consumption. Note, in the corporation was evaluated: the disinfection of equipment, materials, personnel hygiene in their outer clothing, gloves, and allows products are not easily contaminated, which is why microbial growth is below the parameters limits (M) (9-10, 26-27).

Failure high growth of aerobic mesophilic bacteria, thermotolerant coliforms, fungi and yeast because the plantain snack is a food product with low humidity, which does not allow excessive growth of microorganisms (9-10, 28).

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In addition to the microbiological quality evaluated for plantain snacks, other control parameters are needed, such as the quantification of toxic substances. In a study in India the following concentrations of acrylamide were found: 24.8-1959.8 µg/kg for sweet plantain chips, and 14.7-1690.5 µg/kg for plantain chips (29). The results revealed reasonable levels of acrylamide in these foods, which indicated the general risk of consumer exposure, due to powerful neurotoxic effect of acrylamide. Flores-Silva et al., 2015 (30) reported that gluten-free snacks using plantain-chickpea and maize blend may also be useful as an alternative to reduce excess weight and obesity problems in the general population and celiac community. Thus, the snack of plantain could provide beneficial health effects as they have fewer fat, high fiber and low predicted glycemic index, than those reported in similar commercial snacks.

CONCLUSIONS

In none of the ten samples tested were detected microorganisms indicators of impaired quality, reflecting the safety and quality of products made in Corporation INVECA CA, note that the production line is constantly sanitized and products are immediately packaged, in order that exposed the shortest possible time outdoors and thus avoid contamination thereof. Finally the banana chips (Iselitas) are considered fit for human consumption complying with the requirements of microbiological criteria set out in the Technical Standard Health (NTS No. 071-

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