



STUDY OF ENTEROBACTERIA PRESENT IN ATOLE AGRIO FROM VILLAHERMOSA, TABASCO

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Introduction. Atole agrio is a fermented beverage elaborated with young non-nixtamalized maize and consumed in the Southeast region of Mexico, in Tabasco, Chiapas and Veracruz. Maize is ground and a dough is made and shaped into balls with part of the maize, water is added to the other part and both are fermented at ambient temperature. The microbiota of this product is not well defined. Although lactic acid bacteria (LAB) acidify the product, total coliforms and enterobacteria persist or grow in the product (1). Because of this and of the poor hygienic conditions in which it is elaborated, it is necessary to evaluate the presence of enteric organisms, as the Enterobacteria. The objective of the present study was to isolate and identify the enterobacteria and total coliforms from the raw material and from the different stages of elaboration of the atole agrio from Villahermosa, Tabasco.

Methods. Atole agrio was cooked as described in Valderrama (2) and the microbial groups (lactic acid bacteria, amylolytic LAB, total coliforms, yeasts and moulds and enterobacteria) were counted. The enterobacteria were isolated, purified and preserved in 20% glycerol. The isolated strains were identified by phenotypic (API 20E® and Vitek2 system®) methods.

Results. The quantification of the growth of the microbial groups for the liquid fermentation is represented in fig 1. The growth of the microbial groups in the solid fermentation was similar as in the liquid one (Data not shown).

At the end of both fermentations, atole agrio was boiled for 30 minutes and the bacterial growth was, for all the groups less than the method's sensitivity (10 CFU/g). Altogether, 168 strains were isolated; of these, 53 strains were identified as resumed in table 1.

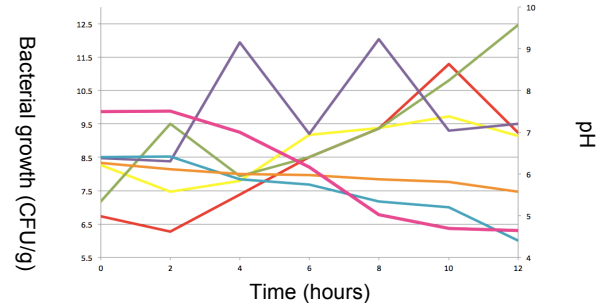


Fig.1 Bacterial growth: BAL yellow; amylolytic LAB, red; moulds and yeasts, green; aerobic mesophiles, purple; coliforms, blue and enterobacteria, orange. In pink pH vs Time (hours) during liquid atole agrio fermentation.

Table 1. Species of enterobacteria identified from atole agrio

Source	Specie of enterobacteria
Raw materials	<i>Serratia marcescens</i> <i>Enterobacter cloacae</i> <i>Klebsiella pneumoniae</i> spp. pneumoniae <i>Pseudomonas aeruginosa</i>
Solid fermentation	<i>Enterobacter cloacae</i> <i>Serratia marcescens</i> <i>Morganellamorganii</i>
Liquid fermentation	<i>Enterobacter cloacae</i> <i>Serratia marcescens</i> <i>Klebsiella pneumoniae</i> <i>Raoultella terrigena</i>

Conclusions. Atole agrio is made by two different methods of fermentation that include a solid and a liquid process. No differences were found in the strains of enterobacteria identified in both fermentations. The strains of enterobacteria found in the liquid and in the solid fermentation are also commonly located in soil, water and in the environment, so, their presence in the atole agrio would be expected. However, search of bacterial pathogens with specific methods is needed.

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