



## MICROBIAL POPULATIONS IN ATOLE AGRÍO: A TRADITIONAL MEXICAN FERMENTED MAIZE BEVERAGE

Gloria Díaz-Ruiz<sup>1</sup>, Anita Valderrama<sup>1</sup>, Karina Esquivel<sup>1</sup>, Judith Espinosa<sup>2</sup>, Dora Centurión<sup>2</sup>, Dolores Reyes-Duarte<sup>3</sup> y Carmen Wachter<sup>1</sup>

<sup>1</sup>Departamento de Alimentos y Biotecnología, Facultad de Química, UNAM, México, D. F.; <sup>2</sup>Universidad Juárez Autónoma de Tabasco, Villahermosa, Tabasco; <sup>3</sup>Departamento de Procesos y Tecnología, UAM-Cuajimalpa, México, D.F.  
[gloriadr@unam.mx](mailto:gloriadr@unam.mx)

**Key words:** atole agrío, fermented beverage, maize

**Introduction.** Most of Mexican fermented foods are beverages, within these those elaborated from maize, are common because it is a staple grain. Traditional fermented foods are produced by natural fermentation, where no inoculum is added. In Southeastern Mexico, maize fermented products as pozol and atole agrío are usually consumed. Atole agrío is a fermented non-alcoholic beverage elaborated with young non nixtamalized maize. The preparation process is carried out in the household and in small-scale (1). The microbiota of this product is not well defined.

The aim of this study was to identify the main stages of elaboration of atole agrío from Villahermosa, Tabasco; to characterize the microbial population and its changes during fermentation process and to identify some lactic acid bacteria (LAB), enterobacteria and total coliforms isolated from raw material and from the different stages of elaboration of atole agrío.

**Methods.** Atole agrío was prepared in a traditional way as described in Valderrama (2). Total mesophilic bacteria, LAB, ALAB (amylolytic lactic acid bacteria), yeasts, molds, coliforms and *Enterobacteriaceae* were counted by the plate count technique from raw materials, during fermentation and from end products, as well as the pH. LAB, ALAB, enterobacteria and coliforms were isolated, purified and preserved in 20% glycerol. The isolated strains were identified by phenotypic methods (API and Vitek2).

**Results.** Atole agrío is made by two different methods of fermentation that include a solid and a liquid process. The main identified stages of process were: dehulling, cleaning, corn grinding and fermentation. To prepare atole agrío, a certain amount of fermented mass and water were heated to obtain a beverage of the desired thickness. Additionally, sugar, honey or species can be added. The results showed higher levels of LAB ( $10^8$ - $10^9$  CFU/ml) than ALAB ( $10^6$ - $10^7$  CFU/ml) throughout the fermentation. After 12h, the level of total mesophilic bacteria was  $7 \times 10^9$ , yeasts and molds  $3 \times 10^9$  and *Enterobacteriaceae* and coliforms  $6 \times 10^5$  CFU/ml. The pH decreased from 7.5 to 4.5. Growth of the microbial groups in the solid fermentation was similar as in the liquid one. At the end of both fermentations, atole agrío was boiled for 30 minutes

and the bacterial growth was, for all the groups less than the method's sensitivity (10 CFU/g).

Some strains of LAB and ALAB were identified throughout fermentation (Table 1). Species of enterobacteria identified from raw material and atole agrío were: *Serratia marcescens*, *Enterobacter cloacae*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Morganella morganii* and *Raoultella terrigena*.

**Table 1.** Species of LAB and ALAB identified from atole agrío.

LAB strains	ATOLE AGRIO		SPECIES
	LIQUID  (l)	SOLID  (s)	
IL5f2	l		<i>Lactobacillus delbrueckii</i>
IIL6f2	l		<i>Lactococcus lactis</i> ssp <i>lactis</i>
IS2f3	s		<i>Lactobacillus plantarum</i>
ALAB strains			
IL2A2	l		<i>Lactobacillus delbrueckii</i>
IL4A2	l		<i>Lactococcus lactis</i>

**Conclusions.** Atole agrío is made by two different methods of fermentation that include a solid and a liquid process. Despite the presence of other microbial groups, LAB and ALAB may have an important role in this beverage. A deeper description of microbial diversity involved in atole agrío fermentation must be carried out.

**Acknowledgements.** Ciencia Básica de CONACYT CB-2008-01 No. 101784.

### References.

- Esquivel K. (2012). Estudio de las enterobacterias presentes en el atole agrío de Villahermosa, Tabasco. Tesis to get Food Chemist Degree. UNAM. 102p.
- Valderrama A. (2012). Diversidad de bacterias lácticas del atole agrío de Villahermosa, Tabasco. Tesis to get Food Chemist Degree, UNAM. 100p.