

OCCURRENCE OF *Candida parapsilosis*, *C. tropicalis*,
AND *Saccharomyces cerevisiae* IN POZOL FROM
TABASCO, MEXICO*By Miguel Ulloa** and
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Mycological studies on pozol (Ulloa, 1974), a fermented maize dough that, diluted in water, is drunk raw as a staple food by the Indian and mestizo populations in several southeastern states of Mexico, have shown that bacteria of various kinds, yeasts of the genus *Candida* and *Trichosporon cutaneum* (de Beurm., Gougerot et Vaucher) Ota, and *Geotrichum candidum* Link are present from the first hours of pozol fermentation and continue growing for several days; as the surface of the pozol balls dries and their pH is lowered, molds such as *Cladosporium cladosporioides* (Fresen.) de Vries, *Neurospora sitophila* Shear & B.O. Dodge and *Mucor rouxianus* (Calmette) Wehmer also invade the substrate to constitute a complex mixture of bacteria, yeasts, and molds.

The 17 yeast isolates obtained and reported by Ulloa (1974) were characterized morphologically and physiologically. Of these isolates, one corresponded to *Candida* sp. No. 1; seven to *Candida* sp. No. 2; three to *Candida* sp. No. 3; two to *Candida* sp. No. 4; and four to *Trichosporon cutaneum*. Only the last yeast species was described in the paper by Ulloa (1974); the rest of the yeasts were not identified to species level.

Now identification has been made of *Candida* sp. No. 1 as *Candida parapsilosis* (Ashford) Langeron et Talice; of *Candida* sp. No. 3 as *Candida tropicalis* (Castellani) Berkhout; and of *Candida* sp. N. 4 as *Saccharomyces cerevisiae* Hansen. *Candida* sp. No. 2 differs from all other *Candida* spp. described in Lodder (1970) and it is currently under study.

The carbon fermentation, carbon assimilation, nitrate reduction, and vitamin deficiency tests, as well as the morphological study, required for the identifica-

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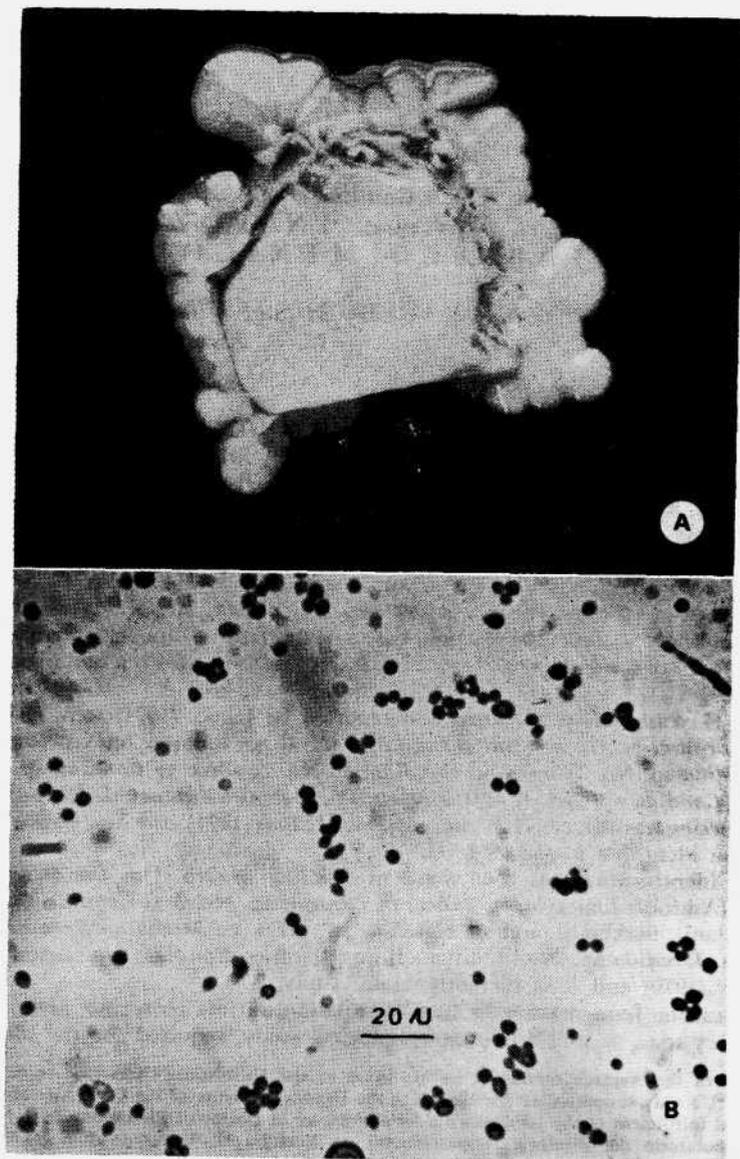


FIG. 1. *Candida parapsilosis*. A, 2-week old colony on malt extract agar. B, budding cells, X 500.

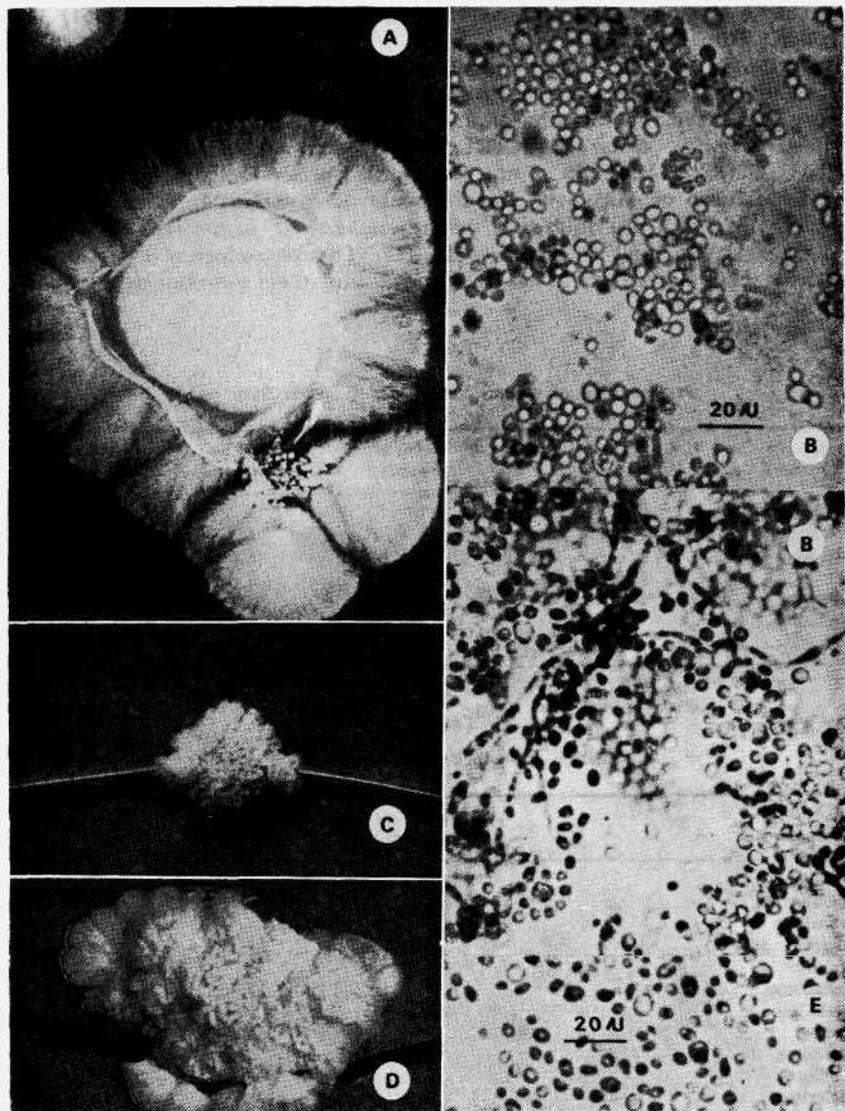


FIG. 2. A, 2-week - old colony of *Candida tropicalis* on malt extract agar. B, pseudomycelium and independent budding cells of *C. tropicalis*, X 500. C, 2-week-old, folded colony of *Saccharomyces cerevisiae* on malt extract agar. D, older colony with fringed border. E, budding cells of *S. cerevisiae*, X 500.

tion of yeasts were performed as recommended by Wickerham (1951) and Lodder (1970).

Cultures of the three yeast species reported here are deposited with the ARS Culture Collection, maintained at the Northern Regional Research Laboratory, and have the following strain numbers: *Candida parapsilosis* NRRL Y-7659, *Candida tropicalis* NRRL Y-7661, and *Saccharomyces cerevisiae* NRRL Y-7662. Subcultures of the same yeast species are also maintained at the Laboratorio de Micología, Departamento de Botánica, Instituto de Biología, UNAM, with the following strain numbers: *C. parapsilosis* U 115, *C. tropicalis* U 116, and *S. cerevisiae* U 117. The physiological characteristics of these yeasts are shown in tables 1 and 2, and their morphology in figures 1 and 2.

TABLE 1

Fermentation of carbon compounds by yeasts from pozol.

Compound	<i>Candida parapsilosis</i>	<i>Candida tropicalis</i>	<i>Saccharomyces cerevisiae</i>
D-Glucose	+	+	+
D-Galactose	Slow, weak	+	+
Sucrose	—	+	+
Maltose	—	+	+
Lactose	—	—	—
Trehalose	+ Latent	+	+ Latent
Raffinose	—	—	+ 1/5

TABLE 2

Assimilation and other tests of yeasts from pozol.

Compound	<i>Candida parapsilosis</i>	<i>Candida tropicalis</i>	<i>Saccharomyces cerevisiae</i>
D-Glucose	+	+	+
D-Galactose	+	+	+
L-Sorbose	+	+	—
Sucrose	+	+	+
Maltose	+	+	+
Cellobiose	—	+	—
Trehalose	+	+	+
Lactose	—	—	—
Melibiose	—	—	—
Raffinose	—	—	+
Melezitose	+	+	—
Inulin	—	—	—
Soluble starch	—	+	—
D-Xylose	+	+	—
L-Arabinose	+	+	—

Cont. table 2

	<i>Candida parapsilosis</i>	<i>Candida tropicalis</i>	<i>Saccharomyces cerevisiae</i>
D-Arabinose	—	—	—
D-Ribose	+	—	—
L-Rhamnose	—	—	—
D-Glucosamine	+	+	—
Ethanol	+	+	+
Glycerol	+	—	+
Erythritol	—	—	—
Ribitol	+	+	—
Galactitol	—	—	—
D-Mannitol	+	+	Weak
D-Glucitol	+	+	—
α -Methyl-D-glucoside	+	+	+
Salicin	—	+	—
Potassium D-gluconate	+	+	—
Calcium 2-Keto-D-gluconate	+	+	—
Potassium 5-keto-D-gluconate	+	+	—
Potassium acid saccharate	—	—	—
Pyruvic acid	+	+	+
Lactic acid	—	+	+
Succinic acid	+	+	—
Citric acid	+	+	—
Ethyl acetoacetate	—	—	—
Inositol	—	—	—
KNO ₃	—	—	—
Vitamin-free medium with glucose	—	—	—
Starch synthesis	—	—	—
Gelatin degradation	±	—	—
Osmotic	+	+	+
Growth at 37 C	+	+	+
Growth at 5 C	—	—	—

Identifying *C. parapsilosis* and *C. tropicalis* in pozol indicates once again the need for good sanitation during food preparation because both yeasts are commonly found as etiologic agents of endocarditis and other diseases of man and animals (Emmons, Binford & Utz, 1970; Jungerman & Schwartzman, 1972). Previously other yeast species also potentially pathogenic to man and to animals, such as *Candida krusei* (Cast.) Berkhout and *Trichosporon cutaneum*, have been isolated from pozol from Chiapas, Mex. (Herrera & Ulloa, 1971). However, tests on pathogenicity of the yeast strains from pozol have not been performed, and, in addition, these species are occasionally isolated from apparent saprophytic habitats.

Candida sp. No. 4, as reported by Ulloa (1974), was identified as *Saccharomyces cerevisiae* after further study. Sporulation occurred on McClary's acetate agar after two months at 25°C. It is unusual to have found *S. cerevisiae*

in pozol, which is not an alcoholic beverage; possibly some ethanol is produced, but swelling or cracking of the pozol balls from gas formation has not been observed.

LITERATURE CITED

- Emmons, C. W., C. H. Binford, and J. P. Utz, 1970. *Medical mycology*. Lea and Febiger, Philadelphia, pp. 178-179.
- Herrera, T. y M. Ulloa, 1971. Estudio de *Candida krusei* y *Trichosporon cutaneum* aislados del pozol. *Rev. lat-amer. Microbiol.* 13: 255-261.
- Jungerman, P. F., and R. M. Schwartzman, 1972. *Veterinary mycology*. Lea and Febiger, Philadelphia, pp. 61-72.
- Lodder, J. (ed.), 1970. *The yeasts*. North-Holland Publishing Co., Amsterdam, 1385 p.
- Ulloa, M., 1974. Mycofloral succession in pozol from Tabasco, Mexico. *Bol. Soc. Mex. Mic.* 8: 17-48.
- Wickerham, L. J., 1951. Taxonomy of yeasts. *U.S. Dept. Agric. Tech. Bull. No. 1029*, 56 p.

SUMMARY

The potentially pathogenic yeasts *Candida parapsilosis* and *C. tropicalis*, as well as *Saccharomyces cerevisiae* have been isolated from pozol (from Tabasco, Mex.), a beverage of Mayan origin prepared from fermented maize dough used as a staple food in southeastern Mexico.

RESUMEN

Este trabajo comunica el aislamiento de las levaduras potencialmente patógenas *Candida parapsilosis* y *C. tropicalis*, así como de *Saccharomyces cerevisiae* a partir de pozol (de Tabasco, México), bebida de origen maya preparada con masa de maíz fermentada, utilizada como alimento básico en el sureste de México.