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## Soya Fortification of Tortilla and Pinole in Chihuahua

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Among the states of the Mexican Republic that produce soybeans, the state of Chihuahua, with 60,000 tons/year (1), produces the best planting seed. About 27% of the inhabitants of the State of Chihuahua do not eat eggs, meat or bread, and do not drink milk. In the rural areas and the mountainous regions where the Tarahumara Indians live, there is an alarming rate of malnutrition, as well as tuberculosis caused by malnutrition, mostly among the Indians. The rural population eats "atole" (gruel made by boiling corn or maize in water) and "pinole" (ground corn), which have very low contents of protein.

Because of this and the fact that 70% of the Mexican diet is corn prepared as tortillas or atole, we decided to look for a way to increase the nutritional quality of corn. We found that, if we add 8% of full-fat soya to corn by the process of extrusion, we can produce a low-cost corn flour enriched with protein and fat. CIATECH, in its fight against malnutrition, received the approval of the President of Mexico, in March, 1979, to set up the first plant which would produce corn flour with 8% soya and make tortillas the same price as commercial corn flour made by the traditional nixtamalization.

This is how ALMESA, Alimentos Mejorados S. A., had its origin; it was the first factory to process enriched corn flour with soya in Latin America. It was decided to set up

this factory in the mountainous region of the state of Chihuahua, near the inhabitants of the rural areas who are mostly Tarahumara Indians.

Adding soya to corn not only increases the quantity of proteins, but also the quality, because soya flour adds tryptophane and lysine which are deficient in corn, and corn, in turn, has methionine to supply the deficiency of soya (2). We obtain a product that is accepted by everyone and, at the same time, contains a high percentage of proteins with a low cost of production. This process saves large quantities of energy and water, and prevents the loss of nutrient in water by the traditional process of nixtamalization.

On November 28, 1979, a very important agreement (3) was signed, so that under the supervision of CIATECH, the Almesa factory would produce 300 tons of corn enriched with soya and 50 tons of pinole with soya for 5,000 children of the 76 boarding schools in the Tarahumara mountains. The factory was inaugurated on December 8, 1979 and to date, has produced 110 tons of corn and 2 tons of pinole.

The federal government has recently created 76 boarding schools where 5,000 Tarahumara children between the ages of 5 and 13 go all week. They are provided food and shelter, and they are taught to read, write and speak Spanish.

TABLE I

Proximate Analysis (%) of Almesa's Products Compared to Lime Treatment Corn (Nixtamalización)

Product	Moisture	Protein	Fat	Raw Fiber	Ash	Carbohydrates
Enriched corn flour	8.78	12.31	5.53	2.66	1.42	78.08
Enriched oat meals	6.70	17.34	11.33	2.86	1.74	60.03
Enriched pinole	6.38	11.91	5.19	2.60	2.07	71.83
Lime treatment corn (nixtamalizado)	10.00	7.50	4.50	1.19	1.00	74.80

The Jesuit priests of the same region have schools very similar to those created by the government, and all those children are given tortillas and pinole enriched with soya, too.

The rural population who live in the surroundings of these Tarahumara Indians are peasants who eat mostly corn, chili and beans, and drink coffee. We found that, due to advertising, they eat a lot of atole made from corn starch (maizena) which has a protein content of 1%. Almesa will provide them with an "atole" of corn and oats fortified with soya, the protein values of which are shown in Table I. The Almesa factory is distributing products to 389,219 inhabitants of the 29 counties (4) of the rural areas and mountainous regions of the State of Chihuahua. From February to August of 1980 it has distributed a total of 110 tons of corn enriched with soya, 3 tons of oats enriched with soya, and ½ ton of fortified pinole.

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## Soy Milk Developments in Latin America

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Soya milk technology was introduced into Latin America by Dr. Miller from the U.S. when he published several papers on soybean products, taken from facts he learned during his stay in the Orient during 1940. From these publications, a Brazilian, Dr. Barretto of Laticinios Mococa, started his first experiments and finally marketed Solein, a mixture of soya milk (30%) and cow's milk (70%), in the year 1967. Solein is produced by cold processing, which results in a milk with beany flavor. Up to now, it has been used in very restricted markets and is being sold mainly in pharmacies. It is powdered and canned.

Almost simultaneously, Dr. Suberbie in Mexico started his experiments which resulted in Sustilac, introduced in 1968. This soya milk is produced by using pregerminated soybeans. The pregermination reduces the amount of oligosaccharides. Companhia Industrial de Alimentos (his company in Mexico) still is producing soya milk. All of its products are in powder form. They also developed Isolac and Soyamalt, which have the following compositions (%):

	Isolac	Soyamalt
Proteins	20.3	24.4
Carbohydrates	47.2	41.8
Fat	25.7	25.7
Fiber	1.7	1.9

Soyamalt is sold in strawberry, vanilla and nut flavors.

In 1968, the Coca-Cola Co. introduced into Brazil the soya milk Saci, which was a sterilized product in liquid form sold in 200-cc bottles. Saci was developed by Coca-Cola to satisfy a United Nations inquiry and had two flavors, chocolate and caramel. The project was a test market, distributed by the same dealers of Coca Cola's soft drinks. Saci reached 8% of total market sales during the years 1968-70. The Saci project was stopped because the company developed another nutritive beverage which could be processed using the same Coca Cola bottling plants and equipment. Saci composition was 3% protein, 1.7% fat and 15% added sucrose. Vitamins A, D, B<sub>1</sub>, B<sub>2</sub>, B<sub>6</sub> and B<sub>12</sub> were added to satisfy 25% of MDR in a 200-cc