

Opuntia-based Ruminant Feeding Systems in Mexico

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Abstract

In Mexico, the arid and semi-arid regions occupy around 50% of the total area. One of the plant resources with a wide range of distribution and uses by man and animals is nopal (*Opuntia*).

The use of nopal as forage in Mexico depends mostly on the utilization of wild nopal communities and less on the cultivated forage, fruit or vegetable plantations.

The *Opuntia* species utilized are numerous and they are used to feed cattle (milk and meat), goats (meat and milk), sheep (meat and wool), horses (transportation and draft), and wildlife. The volumes fed to cattle are around 30-40 kg per day and to goats and sheep around 6-8 kg.

The utilization of the nopal is carried out by large, medium and small rangeland ranches, and in medium and small stables. The methods used by the farmers are reviewed. The comparative advantages of nopal are highlighted and recommendations are given for further research and extension programmes.

KEY WORDS: *Opuntia*, prickly pear, nopal, Mexico, feed, ruminant

Introduction

Opuntia cactus (prickly pear or nopal) is a group comprising plants belonging to different species of the genera *Opuntia* and *Nopalea*, both of the Cactaceae family. Its origin is the American Continent and it can be found from Canada (59 deg. north latitude) to Argentina (52 deg. south latitude), and from sea level to an altitude as high as 5100 m in

Peru (Bravo & Sheinvar, 1995).

The Cactaceae family includes approximately 130 genera and 1500 species. Of these, the *Opuntia* and *Nopalea* genera are the most important due to their usefulness to man. In America, there are two centres of diversification of the Cactaceae family, one in the northern part of the continent and the other in the south. Most of its genera are in one of the two centres; an exception is the *Opuntia* genus, which is found on both sites. There are 258 recognized species of *Opuntia* and 100 are found in Mexico, while the genus *Nopalea* has only ten reported species (Bravo, 1978).

Cactaceae are plants resistant to arid and semi-arid conditions. These conditions in Mexico are characterized by scarce and erratic precipitation, high diurnal thermic oscillation, high annual thermic oscillation and rainfall only in the summer (Flores and Aguirre, 1992).

The arid and semi-arid regions of Mexico cover more than 95 million ha, where annual precipitation ranges from 150 to 600 mm, and the average annual temperature is around 15-25 deg C, with more than seven dry months. Vegetation is composed of grasslands and scrublands, and the plant cover is less than 70% (Jaramillo, 1994).

History and Present-day Importance of Nopal in Mexico

Three main nopal production systems have been identified: wild cactus communities, family orchards and intensive commercial plantations. Although intensive commercial plantations are recent, they were started only 50 years ago, they produce the greatest amount of fruit and vegetable nopal which supplies the domestic and international markets (Flores, 1993). Period in use, products and the total area cultivated per system at present is shown in Table 1.

The use of nopal in Mexico goes back to its first inhabitants. At present, nopal is used in many ways; to name but a few: it is eaten as a vegetable and fruit; it is used for forage, fuel and fences, as well as in medicines, cosmetics and in ceremonies; it produces grana, a natural dye; and it helps to control erosion. The use of nopal as forage for livestock began with the colonization of the north of Mexico by the Spaniards in the 16th century.

Table 1: Period in use, products and total area cultivated under each nopal production system at present in Mexico

Production system	Period in use	Products	Area (ha)
Wild communities	20,000 BC to present	Forage Fruit Vegetable	3,000,000
Family orchards	3,000 BC to present	Fruit Vegetable Forage	unknown
Intensive commercial plantations	1945 to present	Vegetable Fruit Forage Grana	10,400 56,856 150,000 100

Source: Flores, 1993

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Extensive (grazing) animal production systems

Nopal is found naturally on 3 million ha of rangelands in northern Mexico which have, even now, a good plant population density. Another 150,000 ha of nopal were planted by ranchers and small producers with government support.

The livestock fed with nopal are mainly cattle, goats and sheep. But fighting bulls and oxen are also fed with nopal. The two main products of cattle production are calves for export and meat. The goats are used to produce meat and milk, and the sheep to produce meat and wool.

The cattle have a certain amount of blood from breeds such as the Hereford, Charolais, Aberdeen Angus and Beef Master. When the quality of the rangelands is lower, crosses are made with Brahman, Indobrasil, etc.

In goats there has been a more limited degree of cross-breeding with

breeds such as the Nubian, Granadina, Murciana, Alpino Francesa and Sannen. While in sheep, the situation has been similar with limited cross-breeding with Rambouillet, Suffolk and Corridale.

Feeding cattle is based on grazing on rangeland grasses such as *Bouteloua*, *Eragrostis*, *Buchloe*, *Hilaria*, and the introduced *Pennisetum*. All of these are reduced markedly during the dry years. There are also shrubs on which cattle forage like *Prosopis*, *Acacia*, *Celtis*, *Flouencia*, etc., and a great variety of cactus (nopal) (Table 2).

Table 2: Main *Opuntia* species used as forage on the rangelands of northern Mexico

SCIENTIFIC NAME	COMMON NAME
<i>O. streptacantha</i>	Cardon
<i>O. leucotricha</i>	Durasnillo
<i>O. robusta</i>	Tapon
<i>O. cantabrigiensis</i>	Cuijo
<i>O. rastrera</i>	Rastrero
<i>O. microdasys</i>	Cegador
<i>O. lindheimeri</i>	Cacanapo
<i>O. engelmannis</i>	Rastrero
<i>O. azurea</i>	Coyotillo
<i>O. stenopetala</i>	Serrano
<i>O. imbricata</i>	Cardenche
<i>O. fulgida</i>	Choya
<i>O. choya</i>	Choya
<i>O. macrocentra</i>	Chivero
<i>O. chrysacantha</i>	Espina amarilla
<i>O. lucens</i>	Penca redonda
<i>O. duranguensis</i>	
<i>O. tenuispina</i>	

Nopal is fed to livestock using the following methods:

- a) Direct consumption, even though thorns and glochids are present in all these varieties.
- b) For consumption by goats and sheep, mainly on the edge of the nopal, where the concentration of thorns is greatest, and they are cut off.
- c) The whole nopal plant is burned by piling dry brush at the base and burning it in order to eliminate the thorns. However, this method has the disadvantage of causing severe damage to the plant making its recovery difficult.
- d) Utilizing a gas or kerosene burner to burn off the thorns of selected nopal pads without damaging the whole plant.
- e) The best method is cutting off the nopal pads, placing them on the ground, and then burning the thorns off.

The livestock on this kind of rangeland should be given supplements of at least calcium and phosphorus, which can be supplied through the addition of bone meal or blocks with phosphorus and limestone, among other nutrients. Also, it is common to use a mineral premix with salt. In some rangelands during dry seasons, a supplement with protein concentrates (i.e., cotton seed meal, oil seed meals, etc.) is commonly given to livestock. On good rangelands (with leguminous forage plants) the supplements are sources of energy (i.e., maize, sorghum, cane molasses, etc.).

In general, nopal is used during the dry season of the year. However, because there has been a continuous drought in northern Mexico during the last four years, it has been used throughout the year, resulting in deterioration of the nopal communities and a depletion of the resource (Flores and Aranda, 1996). The drought, however, did serve to underline the benefits of using nopal as a feed for livestock on the rangelands. In the last three years, 650,000 head of cattle died in northern Mexico as a consequence of the drought. In general, the ranchers with nopal did not suffer great losses compared with those who did not have or ran out of nopal. Moreover, reproduction rates and levels of production of cattle, sheep and goats are superior when the ranchers supplement the normal diet of the livestock with nopal during the dry season.

Confined livestock

For this system, the nopal is obtained from the rangelands of northern Mexico (3 million ha), from the plantations of forage nopal (150,000 ha), from the plantations of nopal for fruit (cladodes from pruning) in the central region (50,000 ha), and from the plantations of nopal for vegetable (cladodes from pruning) also in the central region (10,500 ha).

Holstein is the most common breed for milk production on small farms of the central and northern regions. Furthermore, small feedlots use nopal to grow and fatten cattle. In this case, the breeds used are the same as those mentioned for the rangelands.

The feeding of the confined dairy cattle consists of nopal supplemented with commercial concentrates and other forages like oats, alfalfa, maize silage and sorghum straw, with additions of premix and common salt.

The species of nopal utilized in these conditions are the same as those used under rangeland conditions. Additionally, *O. lindheimerii*, *O. engelmannii* and *O. rastrera* are used on forage plantations. *O. robusta* and *O. streptacantha* is used in family orchards, and *O. amyclaea*, *O. ficus-indica* and *Nopalea cochinifera* in plantations for fruit or vegetable (nopalito).

Methods used by the farmers to prepare nopal for livestock:

- a) Cutting the nopal. This is done using a knife attached to a bar or tube with a pair of hooks on the opposite end. The hooks are used to lift the cut cladodes and place them on a truck. The main problem here is the level where the nopal is cut, because most of the time the nopal is cut from the root, limiting the possibility of the plant's recovery.
- b) Transporting the nopal. The cut cladodes are transported in large or small sized trucks, or even on carts pulled by animals when the distances are not so great. Unfortunately, with wild species, the sites where nopal can be found and cut have become increasingly further away (100-150 km).
- c) Burning the nopal. When the nopal arrives from the field it is piled up in the yard. As it is needed, it is first spread out and then burned in order to remove the thorns (on both sides of the pad). This can be done with a gas (propane) or kerosene burner. The main problem here is the time that

the nopal can be kept in piles (no more than 10 days). On the other hand, the use of burners is expensive and, in the case of kerosene, drops of fuel are left on the nopal, so the cattle refuse to eat it.

d) Chopping the nopal. Once the nopal is free of thorns, it is chopped and then given to the cattle. The process can be done manually or by cutting machines (usually on farms with more than 50 head). In some cases, the nopal is chopped without burning off the spines and this causes some animals to have problems in their digestive tract.

e) Feeding the cattle. The nopal is carried on wheelbarrows to the feeder stall, and usually it is supplied twice a day. The amount used to feed cattle is around 30 to 40 kg of fresh nopal per day and 6 to 8 kg per day to feed sheep and goats. It has been found that different amounts of nopal are used in different parts of the country. For example, in Saltillo, Coah., 200 tons per day are used, while in Monterrey, N.L., the amount is around 600 tons. There are no data available for other regions.

The results obtained when cattle are fed with nopal have been shown to reduce the total milk or meat production per animal. However, the cost per unit of production is less. Thus, the utilization of nopal offers a good alternative for feeding cattle during the dry season and for lowering milk production costs.

Conclusions

In general, the technical-scientific knowledge on the use of nopal as livestock feed is good. However, knowledge on the sustainable utilization of the wild nopal communities and cultivated forage nopal plantations is limited and only just beginning to be studied.

Planting nopal on the rangelands of the central and northern regions may be the easiest way to improve the vegetation, conserve soil, stop the desertification process, increase the stocking rate, and improve productivity and incomes, and thus the living conditions of the producers of these regions.

The utilization of nopal has been compared with that of fresh alfalfa or alfalfa hay, and/or maize silage, among others. Although lower levels of production have been found using nopal, the costs per unit of production (milk and/or meat) are lower. Therefore, the nopal has been,

is, and will be, an important source of forage for livestock in the central and northern regions of Mexico.

In recent extension work, nopal for forage has been planted in the Mixteca region (Puebla) and in northeastern Mexico (Coahuila, Nuevo Leon, Tamaulipas), as a first stage in a programme that includes: fencing and exclusion, sowing forage shrubs (*Prosopis*, *Acacia*, *Atriplex*, *Agave* etc.), sowing grasses (*Bouteloua*, *Pennisetum*, etc.) and probably eliminating undesirable species (*Larrea*, etc.).

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