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Cactus Pear, Cladodes (*opuntia ficus –indica*); as Forage for Livestock in Arid and Semi-Arids of Ethiopia feeding under a changing climate - A Review

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ABSTRACT

Poor feed quality and lack of water are the major constraints for livestock production under arid and semiarid conditions. Cactus pear (*Opuntia ficus indica*) is an extremely drought tolerant, highly productive, multipurpose and succulent plant. It has incomparably high water and land use efficiency. In cactus pear producing regions of Ethiopia its fruits play life-saving role during rainy seasons while livestock depend mainly on its cladodes during dry seasons and drought years. The problem of feed shortage is more aggravated in arid and semi-arid areas where erratic nature of the rainfall hampers crop production. During the dry season, there is under nutrition and malnutrition of livestock. In this regard cactus pear is known to have great potential. This review provides the effect of supplementation of spineless cactus (*Opuntia ficus indica*) and selected browse species mixture on feed, in order to give the basis of their use in water intake, digestibility and body weight. More studies on *Opuntia ficus-indica* could help better understand its nutritional health, combination with other feeds, fortification mechanism of action to provide clear scientific evidence to explain its traditional uses, and to identify its therapeutic potential in other diseases.

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Introduction

Feed shortage is the main problem of livestock production in arid and semi-arid parts of Ethiopia. Cactus pear (*Opuntia ficus-indica*) is an important forage crop for livestock in some regions of the Ethiopia, mainly due to its drought resistance, high biomass yield, high palatability, tolerance to salinity and adaptability to various soil types (Barbera 1995, Ben Salem et al 1996). However, little has been done to improve the utilization of cactus pear as feed for ruminants.

The arid and semiarid areas are characterized by limited food resources, and the production of green fodder is rare, particularly during the hot and dry season (summer) when the animals are strongly complemented by food concentrate (SAERT 1994). To face these critical periods, the search for other natural resources is needed to better sustain the dairy production and the growth of the young animals and to preserve breeding continuity. In some arid regions, the spineless cactus or prickly peartree (*Opuntia ficus indica*), which is useful for ground conservation and reduction of streaming, is widely cultivated and could be used as green fodder in all seasons.

Today Ethiopia appears to be increasingly interested in the health benefits of foods, feeds and has begun to look beyond the basic nutritional benefits of feed stuffs to prevent disastrous consequences of frequent and severe droughts. It is generally accepted that the beneficial effects of herbal remedies can be obtained from active constituents present in the whole plant, parts of the plant. Cactus belongs to the family *Cactaceae*. The family *Cactaceae* contains about 130 genera and the prickly pear cactus (*Opuntia ficus-indica*) belongs to the genus *Opuntia* (Russell and Felker 1987).

Cactus withstands water shortage, high temperature and poor soil fertility (Barbera 1995), and thus adapted to the arid and semi-arid zones of the world. Ben Salem et al. (1996) also noted the increased importance of cactus as livestock feed in arid and semiarid zones due to its drought resistance, high biomass yield, high palatability and tolerance to salinity. In many arid areas, farmers use cactus extensively as an emergency forage that is harvested from both wild and cultivated

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stands to prevent the disastrous consequences of frequent and severe droughts. World wide about 900,000 ha of cactus are cultivated for forage production (FAO 2001). Cactus is highly palatable and in conjunction with conventional roughage sources can maintain adult sheep during scarcity of feeds (Sirohi et al 1997). Moreover, the succulent pads of cactus serve as source of water for livestock in dry areas. In arid and semi-arid areas of Ethiopia, cactus serves to bridge the gap of feed shortage during the dry season. Despite the wide use of the plant, only little effort has been made to improve its utilization as feed to ruminants. Data on its nutritive value and digestibility is scarce. Based on these, the objectives of this paper were to review the effects of different levels of supplementation of cactus pear as forage on feed intake for sheep and goat in arid and Semi-arid in Ethiopia, under a changing climate.

Table 1.Nutrient and chemical Composition of the feed type

S/N	Feed type	DM(kg)	OM	CP	NDF	ADF	ADL	Hemicelluloses	Cellulose	Soluble carbohydrates	Ether extract	Non-structural carbohydratesb	ADF-ash	Ca	P	References
1	Spineless cactus	913.1	719.9	61.3	387.6	199.9	48.8	-	-	-	-	-	280.1	-	-	(Daniel Tadesse *et al 2014)*
	Cactus+A.Saligna	904.1	783.2	82.3	476.9	322.6	95.7	-	-	-	-	-	216.8	-	-	
	Cactus+*A.robusta*	911.5	809.9	127.9	415.5	273.3	62.5	-	-	-	-	-	190.1	-	-	
	Cactus+*S. sesban*	904.2	801.3	185.7	372.4	206.8	48.1	-	-	-	-	-	198.1	-	-	
2	Cactus	120	725	83	392	0	50	129	213	251	-	-	0	45	2.6	(Tikabo Gebremariam *et al 2006)*
	Teff straw	930	911	76	705	nd	50	319	320	131	-	-	nd	nd	nd	
	Noug seed cake	940	918	252	518	nd	124	162	195	149	-	-	nd	nd	nd	
3	Cactus	86.0	768.6	63.3	238.5	140.2	21.9	-	-	-	6.5	460.3	-	-	-	(Amare Degu etal 2009)
	Teff straw	908.2	910.5	78.8	694.2	374.7	41.8	-	-	-	23.2	114.3	-	-	-	
	cotton seed cake	918.1	923.0	430.0	265.2	110.9	27.4	-	-	-	12.3	215.5	-	-	-	
	Noug seed cake	921.8	900.1	320.0	368.9	270.3	110.4	-	-	-	63.3	147.0	-	-	-	
	peanut seed cake	923.2	944.0	420.0	197.7	80.5	12.9	-	-	-	135.7	568.6	-	-	-	
4	Cactus pear	12.23	-	5.1	23.88	16.24	3.06	-	-	-	-	-	19.89	-	-	
	Hay	92.95	-	9.41	68.53	38.60	4.97	-	-	-	-	-	11.48			Firew Tegegne et al .(2002)

DM: dry matter; OM: organic matter; CP: crude protein; NDF: neutral detergent fiber; ADF: acid detergent fiber; ADF-ash: acid detergent fiber ash; Ca: calcium; P: phosphorous.

Cactus Pear as Forage

In Tigray, most of the feed supply for livestock comes from the arable land and in a year of normal rainfall, about 45% of the total feed supply of cattle in terms of nutrients comes from crop residues and 20% comes from stubble grazing (Melaku 1997). The crop residues are utilized mostly in the months of February to early August. During these periods, cactus is the main feed source when the crop residue alternative is not present in the cactus growing zones of Tigray. All livestock types (cattle, sheep, goats, camels and equines) are reported to consume cactus pear. Cutting the cladodes and superficial burning to eliminate spines and chopping are the dominant form of processing.

Few use scraping or rubbing to eliminate spines. Farmers burn both sides of the cladodes by putting straw or firewood on the cactus. To save firewood some households prepare traditional oven and add small amount of fuel on it. Traditional sharp materials like knife and sickle are used to cut and chop the cladodes; none of the farmers were using specially designed tools. In order of importance, cattle, sheep and sheep are fed with processed cactus, either because they are preferred or their inability to graze *in situ*; only 15% of the farmers prepare cactus for equine while camels and goats do not face problems to browse even the spiny cactus (Firew Tegegne *et al 2008).*

Almost all kinds of livestock can feed on cactus including cattle, camel, sheep and goats but may differ in the stage of growth preferred, further treatment required to increase the palatability and the type of cactus plantation. Cattle and sheep can be allowed to freely graze on a dense natural cactus plantation like that of '*Mehonie*' (Southern zone) where they could selectively eat the young and spineless cladodes without any further treatment. But this is not usually the case as such dense plantations are either far away from settlement areas or there could be threats from wild games (Haile and Belay 2002).

Chemical composition of Feeds

Spineless cactus had a high water content of 880 g/kg fresh weight (Table 1). The cactus pads had high ash (mineral content), especially calcium (45 g/kg DM), but the phosphorus concentrationwas 2.6 g/kg DM, making the ratio of calcium to phosphorus 17:1. The soluble carbohydrate of cactuswas over 251 g/kg DM, whereas itwas only 130 g/kgDMin the basal diet. Also the CP content of cactus (83 g/kg DM) was higher compared to that of tef straw (76 g/kg DM). However, high contents of NDF and ADF were determined in tef straw compared to that in cactus pads.

Cactus was readily consumed and the animals preferred it to tef straw. Consumption of cactus dry matter intake (DMI) increased with increasing level of cactus inclusion (Tikaba Gebremariam et al 2006). The high moisture content of cactus (Tikaba Gebremariam *etal*.,2006) Table (1) was similar with other studies (Nefzaoui et al 1993, Ben Salem and Nefzaoui 2002) which done in other countries. This indicates that the water content in the cactus pads could solve the problem of water scarcity, particularly in the dry season for animals in arid and semi-arid zones of Ethiopia. The high water content of cactus could help to resolve the problem of watering animals in dry seasons or in areas where there is a limitation of water. The CP content was in the range 5–12 g/kg DM (Felker 1995) but several researchers reported lower CP content for cactus. Other experiments (Ben Salem et al 1996, Mengistu 2001) have reported cactus to be rich in readily available carbohydrates, which could serve as a source of energy for animals. Due to this, cactus could be used as a supplement for animals on poor

quality roughage such as straw and the combination of cactus with cereal straw could be a nutritionally satisfactory solution for maintaining small ruminants in arid zones.

The high calcium to phosphorus ratio (17:1) (Tikaba Gebremariam et al 2006) which was far from the general accepted safe range ratio, which is 1:1 to 2:1 (McDonald et al 2002). Ben Thlija (1987) attributed the high calcium content of cactus to the high Ca but low moisture content of arid soils that promotes the accumulation of high levels of Ca in cactus. Calcium accumulates in plants during period of drought, but reduces in concentration when the soil moisture is high; on the other hand phosphorus appears to be present in higher concentrations when the rainfall is high (McDonald et al 2002).

The low fiber content of cactus relative to the fiber content in the basal feed (Tikaba Gebremariam *etal*.,2006) was comparable with the results of Mengistu (2001) and Ben Salem and Nefzaoui 2002) who reported NDF content of 241 and 255 g/kgDMin cactus, respectively. Forages with high fiber contents have poor DMI due to their rumen fill effect as well as low digestibility.

According (Daniel Tadesse et al 2014) the dried, chopped and grounded spineless cactus had CP content of 61.3 g/kg DM (Table 1) which is lower than that of the hay (67.5 g/kg DM). However, the CP content of each of the treatment feeds is cactus +*A. saligna* 82.3, cactus +*A. robusta* 127.9, cactus +*S. sesban* 185.7 g/kg DM is much higher than that of hay and spineless cactus. High content of OM, NDF and ADF were determined in the hay compared to the treatment feeds. The spineless cactus cladode (pads) has high ash content (280.5 g/kg DM) (Daniel Tadesse et al 2014). The NDF (387.6 g/kg DM) and ADL (48.9 g/kg DM) contents of cactus pad obtained in this study are higher than 289 and 40 g/kg DM; however, the ADF content (199.9 g/kg DM) is lower than 219 g/kg DM reported by (Amare D et al *2009)*

Cactus had a low DM, CP, NDFom, ADFom, and ADL, but high non-structural carbohydrates, water and ash contents (Table 1). Contrary to the chemical composition of cactus, tef straw contained high NDFom, ADFom and ADL fractions. The CP content of tef straw used in this study was relatively high for the kind of feed. The oil seed cakes had high CP. The NDFom, ADFom and ADL contents were higher for NSC and relatively lower in PNC, whereas the content of ether extract was higher in PNC and lower in CSC.

Conclusion

Cactus pear is presented as forage and satisfies the water requirement of animals and thus serves to mitigate water problems in the dry season and during drought. Moreover, cactus may improve the nutritive value of poor quality roughage due to its high content of soluble carbohydrates. It may promote reasonable live weight gain in livestock fed diet. Therefore, the different cactus browse mix could be used as strategic feed supplements during the dry season.

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