

Cactus based feeding strategies for enhancing small ruminant productivity

International Cactus Pear Workshop
Development of a cactus pear agro-industry for the sub-Sahara Africa Region

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Outline

1. Outlook
2. Main challenges and Concerns
3. Some characteristics of cactus
4. Options to use cactus
5. Economic value of cactus
6. Concluding remarks

Livestock, food security and livelihood

- Livestock products provide: **13% of dietary energy** and **28% dietary proteins** worldwide
- Livestock contribute to the livelihoods of over one billion people as a source of **income, food, draught power, hides, fibre, manure, biogas**
- In some African countries, contribution of livestock to agricultural GDP can be as high as 80%

Consumption of livestock products

World demand for livestock food products since 1990:

Milk + 30% Meat + 60% Eggs + 80%

+ 70% by 2050

Driven by:

- *Increasing population*
- *Urbanization*
- *Increasing economies*

Future feed demand

In 2012-2013: 795 million tonnes of cereals (1/3 cereal production)

By 2050: an additional 520 million tonnes

Monogastric sector

In 2013: Consumed 155 million tonnes of feed protein

In 2030: Additional 52 million tonnes of feed protein

In 2050: Additional 110 million tonnes of feed protein (40% from cereals and rest 60% from other protein sources)

In 2013: 110 million tonnes of coarse grains used for bioethanol

Challenge -- to meet the feed demand when faced with:

- Food-feed-fuel competition
- Decrease in arable land for crop production
- Increase in population
- Water shortage
- Limited supply of phosphorus
- Frequent climate extremes
- Animal and Human health risks
- Economic instability

Dryland concerns and challenges: grave

- Drylands cover more than 40 % of the world's land area
- Home to 2.5 billion people— 1/3 of global population
- Of these, 1/3 depend on dryland agricultural for food security & livelihoods
- Widespread: poverty, food insecurity, frequent drought & land degradation and desertification (CC will only increase these problems)
- Characterized by water scarcity, the dry areas have < 8% of the world's renewable water resources
- Poverty is disproportionately concentrated in dry areas

Opportunity

A tremendous resource

Africa has vast livestock resources (247m cattle, 255m sheep, 277m goats, 32m pigs, 16m camels and 1.7b chickens) and could be a major player in the global livestock trade.

- Engine for development
- Means to overcome malnutrition

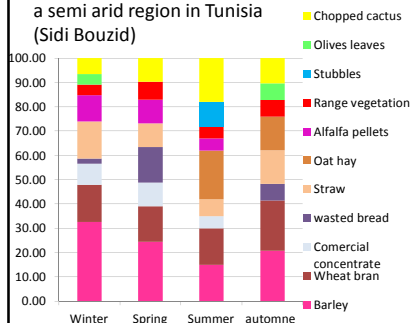
Options to improve livestock productivity

- Produce more with less inputs (mainly water)
- Cost-effective and simple approaches could improve livestock performances in dry areas
- Balanced feeding to reduce production gap
- Use of drought tolerant & high water-efficient feed resources (e.g. cactus, non-toxic Jatropha and Moringa)
- Lesser known, adapted to harsh conditions, alternative feed resource (Bioactive compounds: decrease CH₄, pressure on rangelands,..)

Integration – Key to Profitability & Sustainability!

Cost-effective feeding – A challenge in the dry areas

Diet composition for sheep in a semi arid region in Tunisia (Sidi Bouzid)

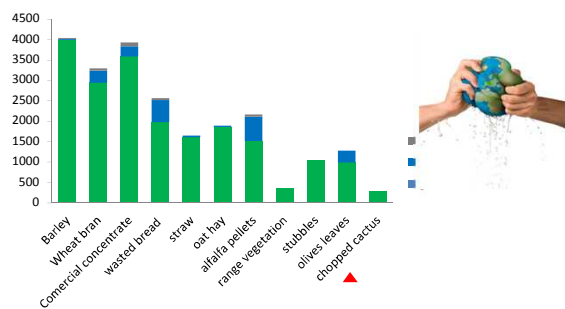


- Cactus is used year-round
- High proportion of concentrate feeds
- Low contribution of range biomass
- Unbalanced diets for main nutrients
- High cost of feeding

Cherif & Ben Salem (2014)

Cactus – A promising species

Cactus has low Water Footprint (Liter of water to produce 1 kg)



Tunisia

Ibidhi & Ben Salem (2014)

Methodology: Water Footprint Assessment Manual (Hoekstra et al., 2011)




Nutrient contents of cactus cladodes & fruits growing in Tunisia


Cactus cladodes		<i>O. amyclae</i> (fruit)	
DM	10 – 15% DM	DM (%)	19
Ash	15 – 30% DM	OM (% DM)	95
CP	3 – 7% DM	CP (% DM)	5
NDF	25 – 40% DM	OM digestibility (%)	68
ADL	1 – 3% DM	CP digestibility (%)	50
Ca	3 – 8% DM	ME (MJ / kg DM)	12
P	0.1 – 0.3% DM		
K	3 – 8% DM		

Yousfi and Ben Salem (2013)

Options to use cactus



Ingredients (%)	
Cactus fruits	30
Olive cake	37
Wheat bran	15
Quicklime	10
Urea	4
Salt	4





Chemical composition (% DM)	
DM (%)	86
OM	64
CP	22
NDF	32
Ca	15
P	9
ME (MJ/kg DM)	15

Ben Salem (unpublished)

Options to use of Cactus

Wasted fruits in feed blocks to replace barley

Lambs	Daily gain (g)
Hay + barley	154
Hay + feed block (cactus fruits)	163

Chermi & Ferchichi (2000)

Options to use Cactus

Fruits & cladodes in a dried or ensiled mix

Ingredients	%
Cactus fruit (juice)	45
Cactus cladodes (dried & ground)	06
Wheat bran	20
Sugar beet pulp	16
Straw	16
Salt	01
Urea	01
MVS	01

Morocco

Araba et al. (2013)

Options to use Cactus

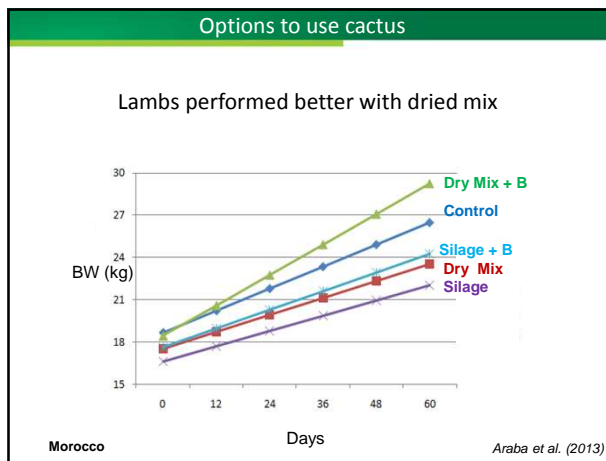
Fruits & cladodes in a dried or ensiled mix

Diet composition

Ingredients	Cont.	Mix dry	Mix dry + B	Silage	Silage + B
Straw	50%	-	-	-	-
Mix dry	-	Ad lib	Ad lib	-	-
Silage	-	-	-	Ad lib	Ad lib
Commercial feed	50%	-	-	-	-
Barley	-	-	200 g	-	200 g

Morocco

Araba et al. (2013)



Options to use cactus

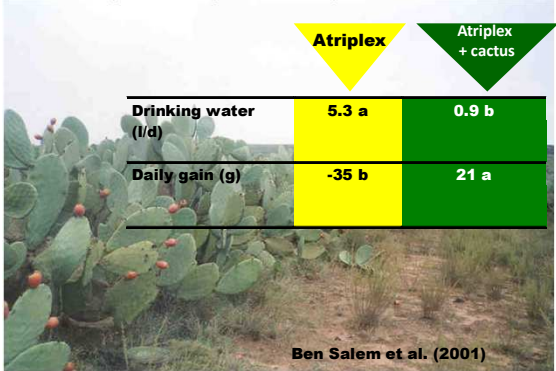
Total replacement of barley with cactus as supplement with straw had no effect on the growth of kids

	Cactus	Barley	S.E.
Hay intake (g/kg W ^{0.75})	39.1	48.6	5.9
OM digestibility (g/kg)	644	628	16
N balance (g/d)	3.0	3.9	0.7
Daily gain (g)	37.2	45.8	7.3

TunisiaAbidi et al. (2010)

Options to use Cactus

Complementary role of Atriplex and Cactus




	Atriplex	Atriplex + cactus
Drinking water (l/d)	5.3 a	0.9 b
Daily gain (g)	-35 b	21 a

Ben Salem et al. (2001)

Options to use Cactus

Complementary role of shrub species

Weaned lambs fed on straw



	Barley	Barley	Cactus	Cactus
	Soybean	Atriplex	Soybean	Atriplex
Growth (g/d)	108 a	59 c	119 a	81 b

TunisiaBen Salem et al. (2004)

Options to use Cactus

Meat quality of kids

Diet 1: Oat hay (600 g) + Soybean meal (200 g) + Cactus
 Diet 2: Oat hay (600 g) + Concentrate (600 g)

- No effect on PUFA, MUFA & SFA
- CLA increased in the meat of cactus-kids

Zouaghi et al. (2005) - Tunisia

Meat quality of lambs

Diet 1: Silage (cactus-olive cake-wheat bran) + Soybean meal (200 g) + Cactus
 Diet 2: Oat hay + Concentrate

- No effect on PUFA & MUFA
- Silage decreased SFA

Vasta et al. (2008) - Tunisia

Options to use Cactus

Cactus vs Barley on reproductive traits in ewes

Barbarine ewes: Late gestation-early suckling

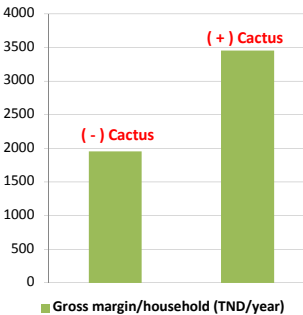
Diet 1: Oat hay + barley + Soybean meal
 Diet 2: Oat hay + cactus + Soybean meal

No effect on:


- Colostrum production
- Colostrum immunoglobulin G (160 vs 149 g/liter)
- Milk yield at 30 days (1030 vs 1041 g/day)
- Live weight of lambs at 30 days of age
- Ovarian activity at 30 days from lambing

Rekik et al. (2010) - Tunisia

Impact of Cactus on farmers' income



(-) Cactus	(+) Cactus
~1800 TND/year	~3500 TND/year



Net benefit/sheep increased with cactus incorporated in diet (26 sheep per household)

TunisiaDaly & King (2014)

Alternative land uses in dry areas (Sidi Bouzid/Tunisia)

TND/ha - 2013

Non intervention : Rangelands

Alternative land uses	Farmers (Net income)
Cactus	1220
Cactus in alley + Pasture	1669
Cactus in alley + Barley	1913

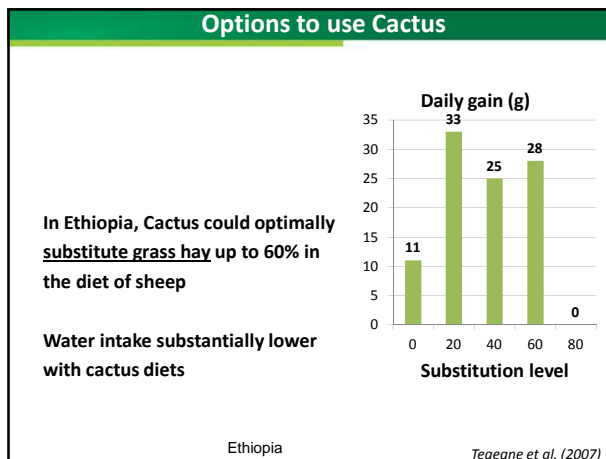
Cactus in alley enhances the value of rangelands

Non intervention : Rainfed barley

Alternative land uses	Farmers' (Net income)
Cactus	977
Cactus in alley cropping with barley	1669

Cactus in alley is more profitable than cropping only barley

Daly & King (2014)



Options to use Cactus

Cactus and wheat bran to supplement treated (urea)/non-treated straw for sheep

Diets	DMI (g/day)	ADG (g/day)
Straw (S)	421e	-22.0d
S + Cactus (C)	583c	-27.5d
S + C + Wheat Bran	715b	+41.5b
Urea-treated Straw (UTS)	640d	+14.0c
UTS + Cactus (C)	853a	+38.0b
UTS + C + Wheat Bran	857a	+75.50a

Straw – source of fiber
Cactus – source of energy
Wheat bran – source of nitrogen

Ethiopia *Tegegne et al. (2005)*

- ### Concluding remarks
- Inadequate year-round supply of feed resources
 - Cactus holds promise to improve livestock production in the areas including North and sub Saharan Africa
 - Use of cactus could reduce the amount of concentrate feeds, decrease feeding cost
 - Cactus use decreases water consumption by animals
 - It grows in arid areas where other crops can not grow
 - It is rich in energy and has low fiber and CP concentrations
 - The promotion of cactus would boost the productivity, ensure sustainability of livestock-based production systems in the dry areas and enhance farmers' income



www.feedipedia.org

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