



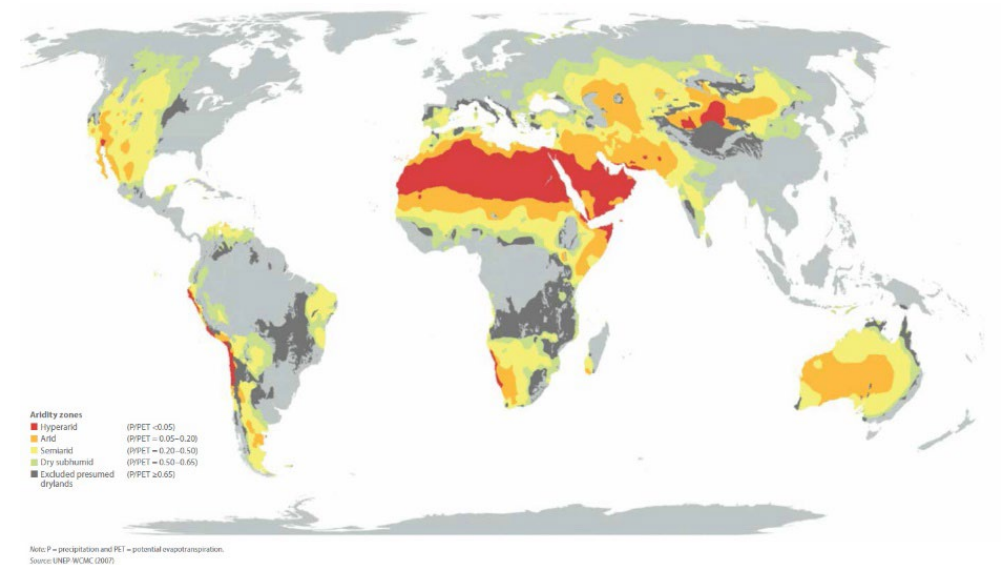
Cactus (*Opuntia* sp.) Potential as Fodder, Pellet, or Silage

Jose Dubeux, Marcio Cunha, and Andre Magalhaes



Drylands in the world

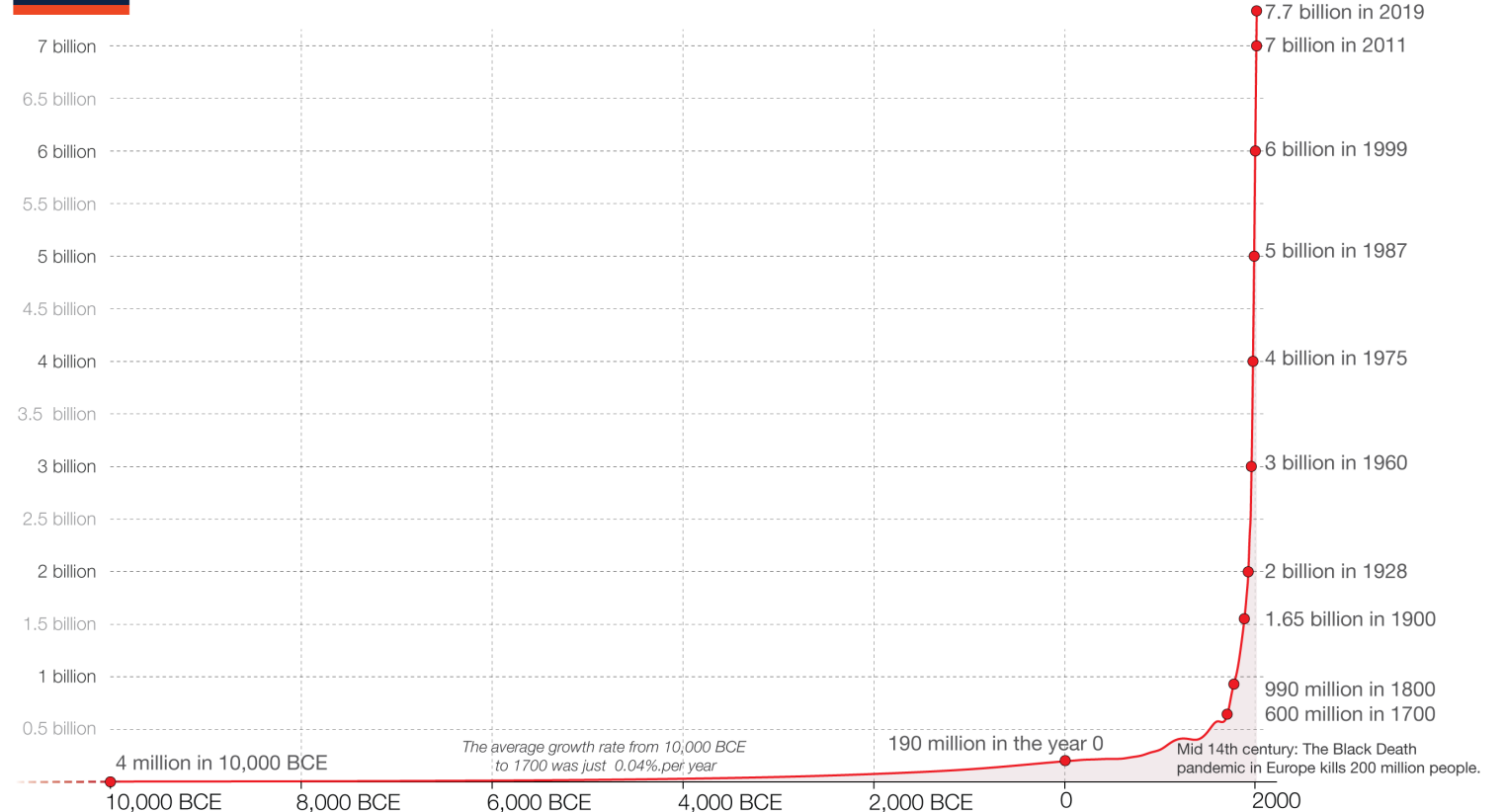
- 40% of the global terrestrial area
- 30% of world's human population
- 50% of world's livestock
- 35% of all terrestrial carbon fixation
- 61% of land use related to pastoralism and grasslands



The role of drylands will increase in the near future



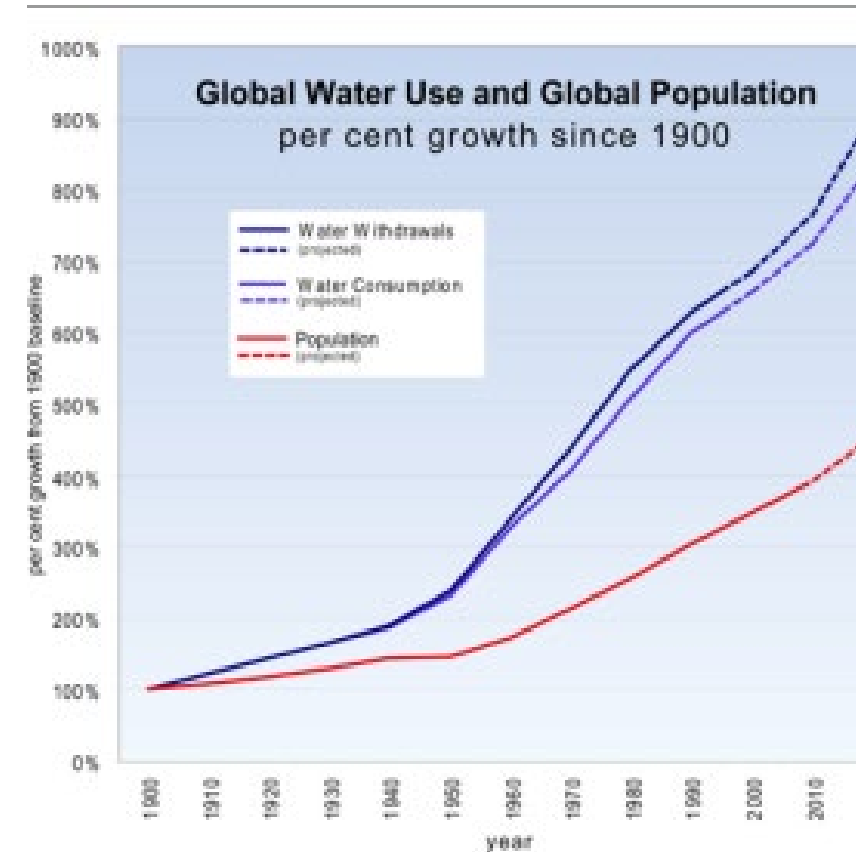
The size of the world population over the last 12,000 years



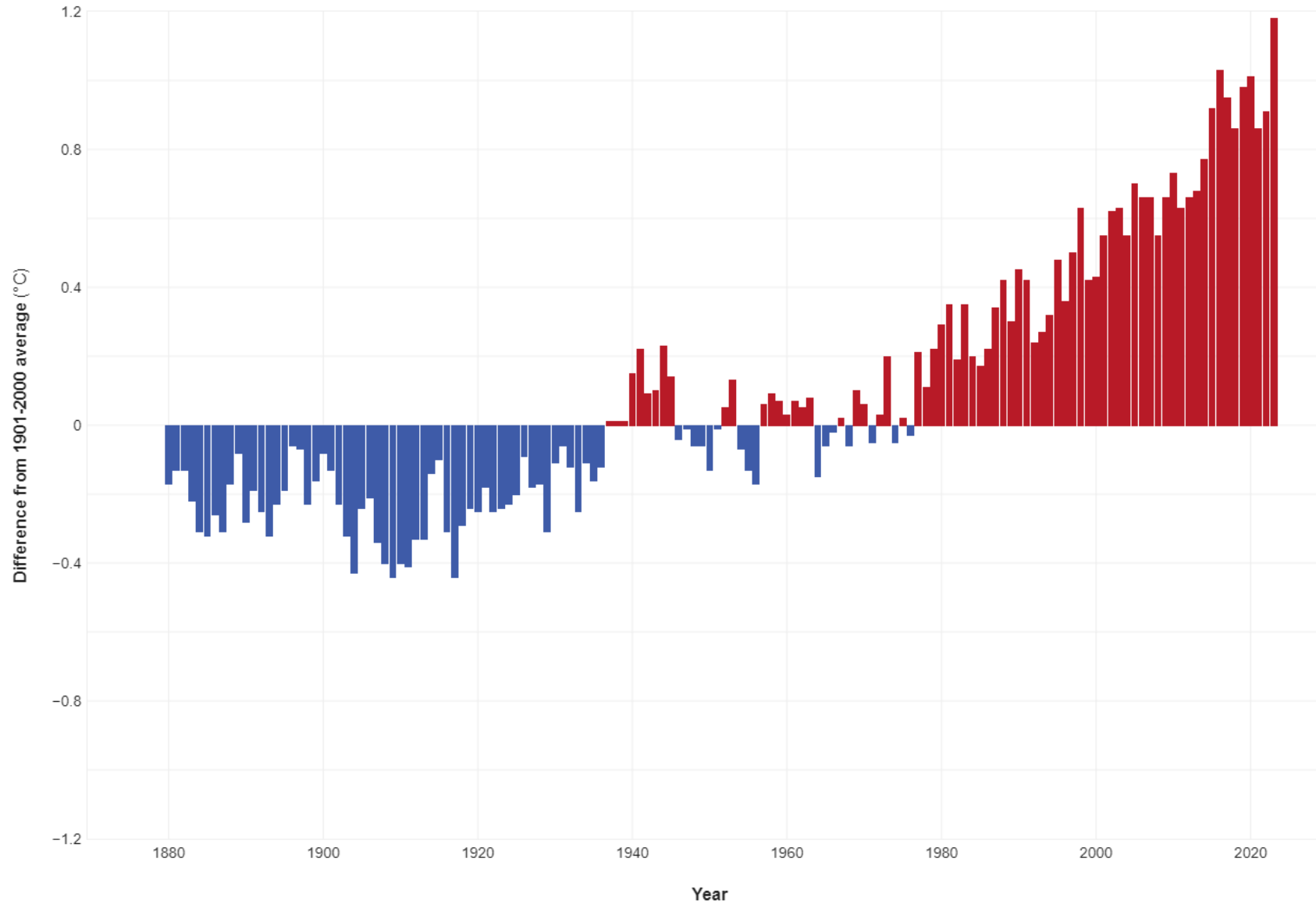
Based on estimates by the *History Database of the Global Environment* (HYDE) and the United Nations. On [OurWorldinData.org](https://ourworldindata.org) you can download the annual data. This is a visualization from [OurWorldinData.org](https://ourworldindata.org), where you find data and research on how the world is changing. Licensed under [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) by the author Max Roser.

Water Consumption

- Global water consumption increasing
- Need to use drought tolerant plants and livestock
- Adapted to drylands
- Potential source of water for livestock
- Good fit for cactus !!



GLOBAL AVERAGE SURFACE TEMPERATURE



The 10 warmest years in the historical record have all occurred in the past decade (2015-2024)

2024 was the warmest year since global records began in 1850 by a wide margin

Increasing drought frequency

Climate change to make droughts longer, more common, says UN

By WANJOHI KABUKURU May 11, 2022



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FORAGE TEAM

In the current scenario....

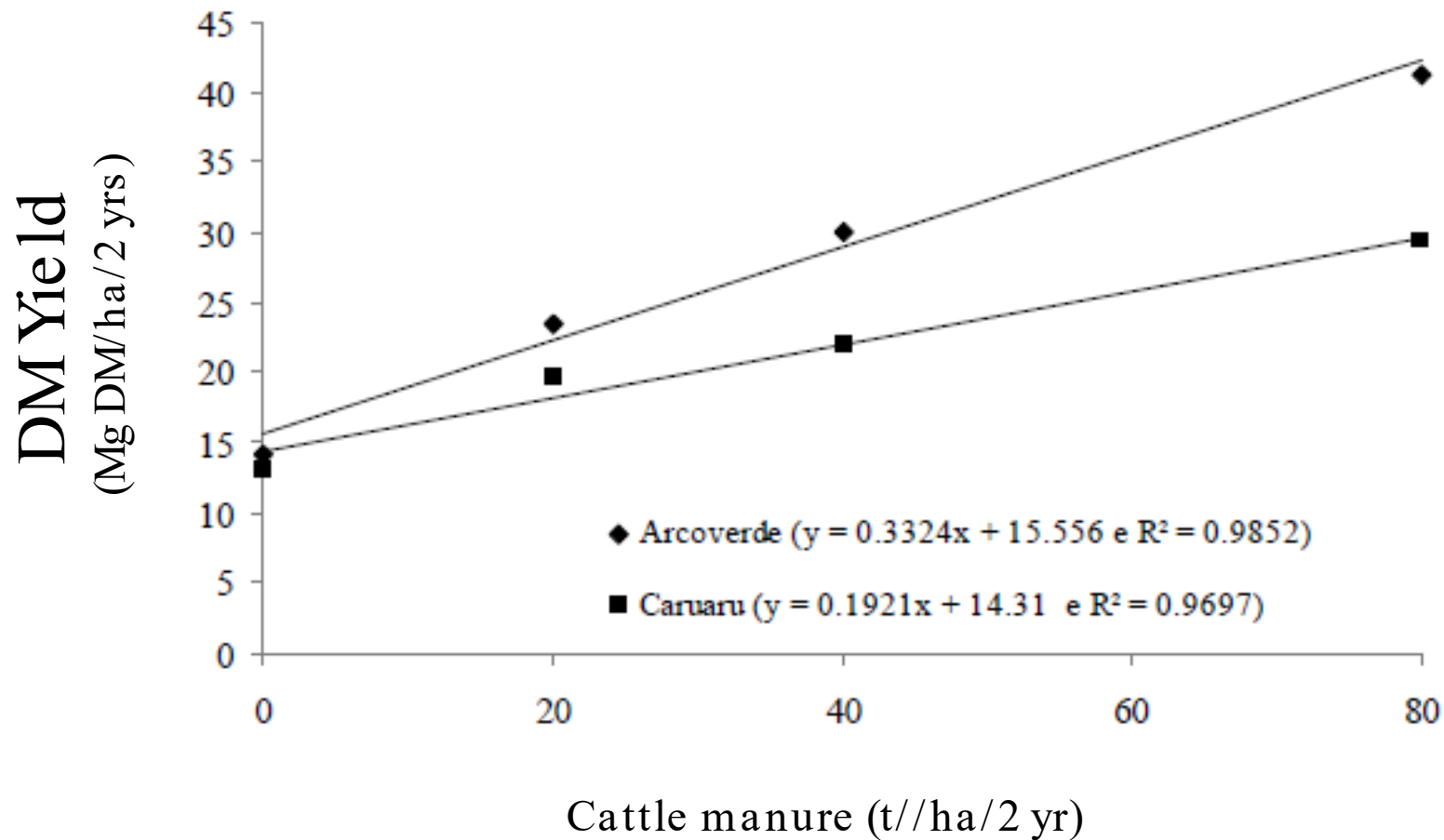
- Cactus is a key crop for the future
- Increase from 12.8 to 16.3 t DM/ha/yr when CO₂ increased from 350 to 650 ppm (Nobel e Cortázar, 1991)
- Drought tolerant and efficient using water
- Cactus provides multiple ecosystem services in drylands



Rangeland productivity in the world

Rangeland type	Location	Annual rainfall (mm)	Annual productivity (kg DM ha ⁻¹)	Carrying capacity (AU ha ⁻¹)	Reference
Grassland	Bloemfontein	560	1,558	---	Snyman (2002)
Savanna	Pongola region	568	2,100-3,500	0.24	Fynn and Connor (2000)
Shrubland	W Australia	228	625	---	Holm et al. (2003)
Mixed-grass rangeland	Wyoming	384	816-1,224	---	Schuman et al. (1999)
Prairie	NW Oklahoma	576	1,490	0.17	Gillen and Sims (2004)
Eucalypt woodland	NE Queensland	535	2,800	1.63*	Ash et al. (1995)
Caatinga + Buffel	NE Brazil	605	1,940	0.16	Ydoyaga Santana et al. (2011)

Cactus Agronomic Potential



Santos et al. (2009)

Cactus Agronomic Potential

- ✓ Potential productivity of 20 Mg DM/ha/yr (and 180 Mg/ha/yr of water)
- ✓ Carrying capacity of 4.8 AU/ha/yr
- ✓ This is 57.6 x greater than the carrying capacity of native rangeland (12 ha/AU/yr)
- ✓ In low-input systems, 5 – 6 Mg of DM/ha/yr is easily obtained

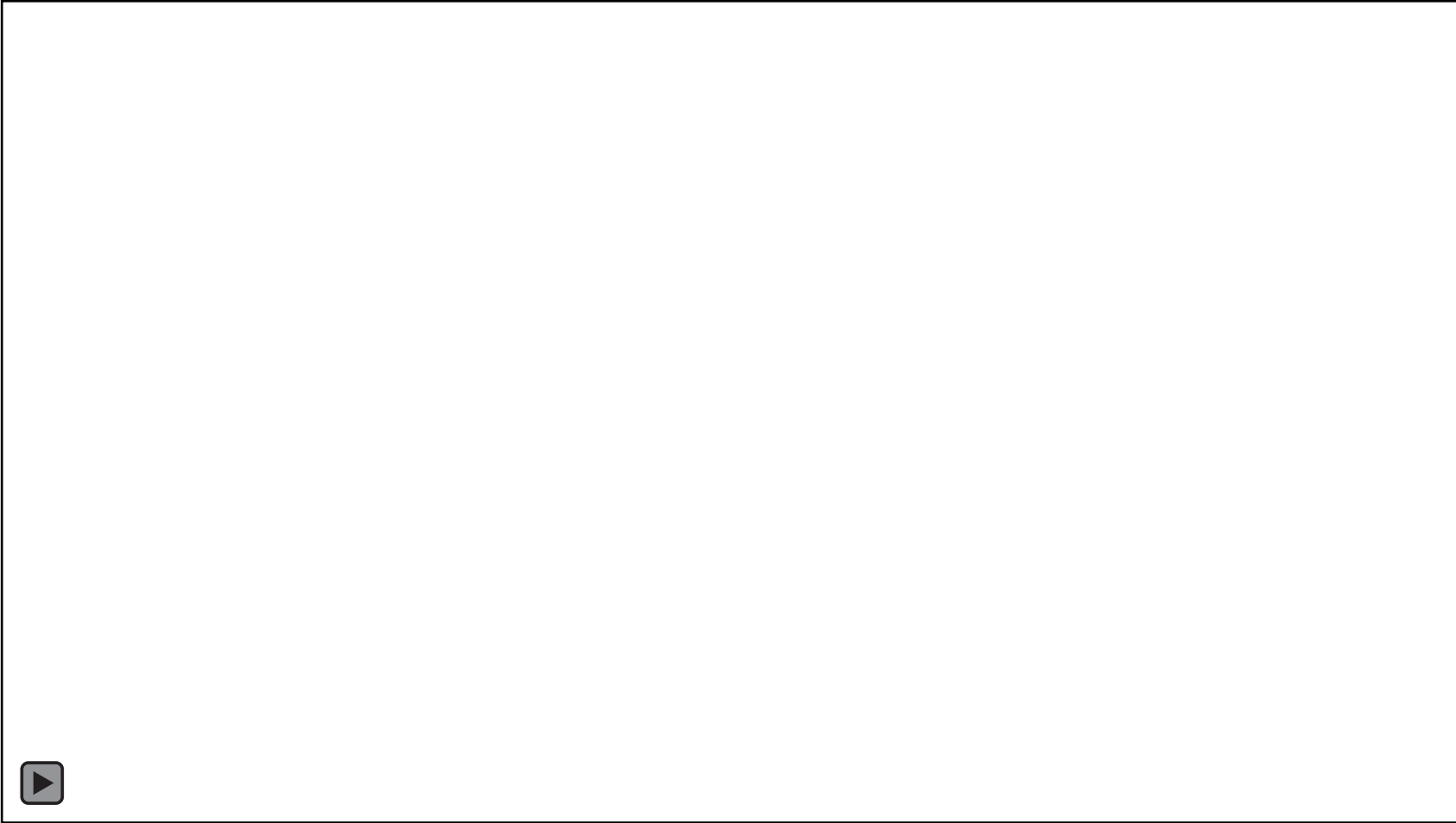


Cactus replacing maize

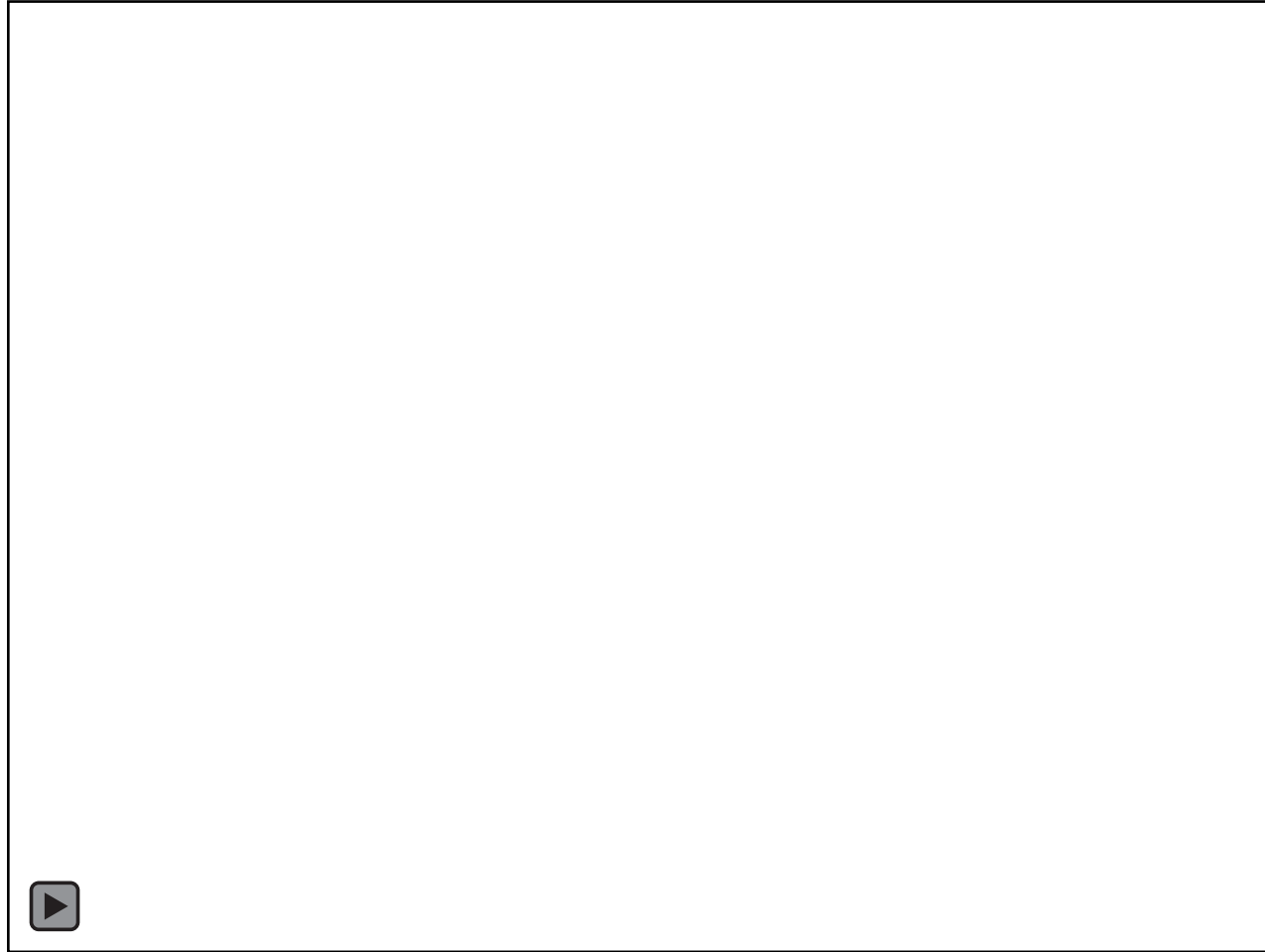
Cactus represents 80% of
maize grain feed value,
but produces at least 20 x
more in harsh semiarid
environments



Cactus harvesting machine developed in Brazil



Feeding System for Chopped Cactus



Direct Browsing on Cactus





Cactus (*Opuntia* spp.) chemical composition

- Cultivar
- Development stage
- Fertilization
- Plant population
- Cladode order



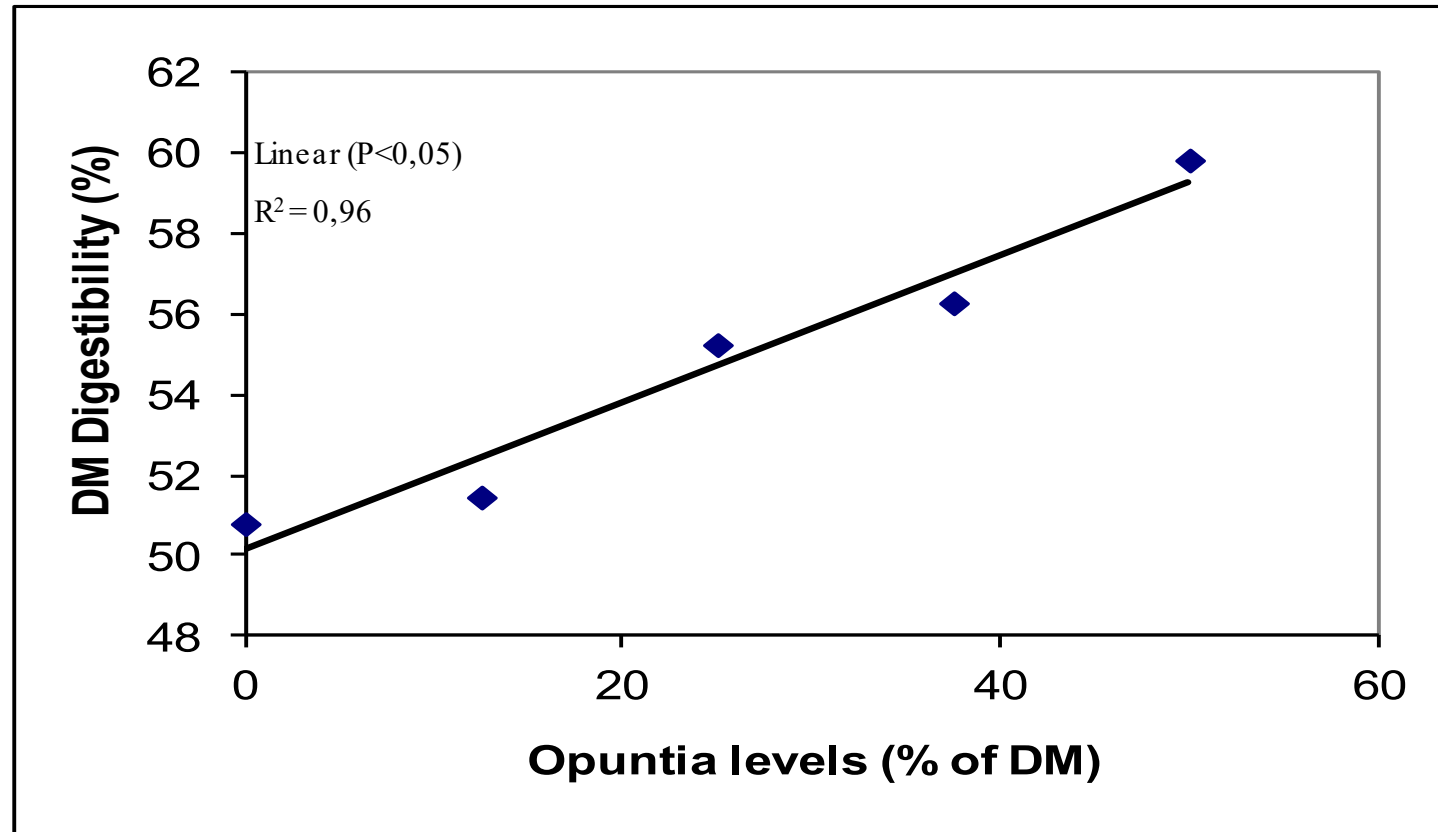
OPUNTIA - AVERAGE CHEMICAL COMPOSITION



1- DMbasis

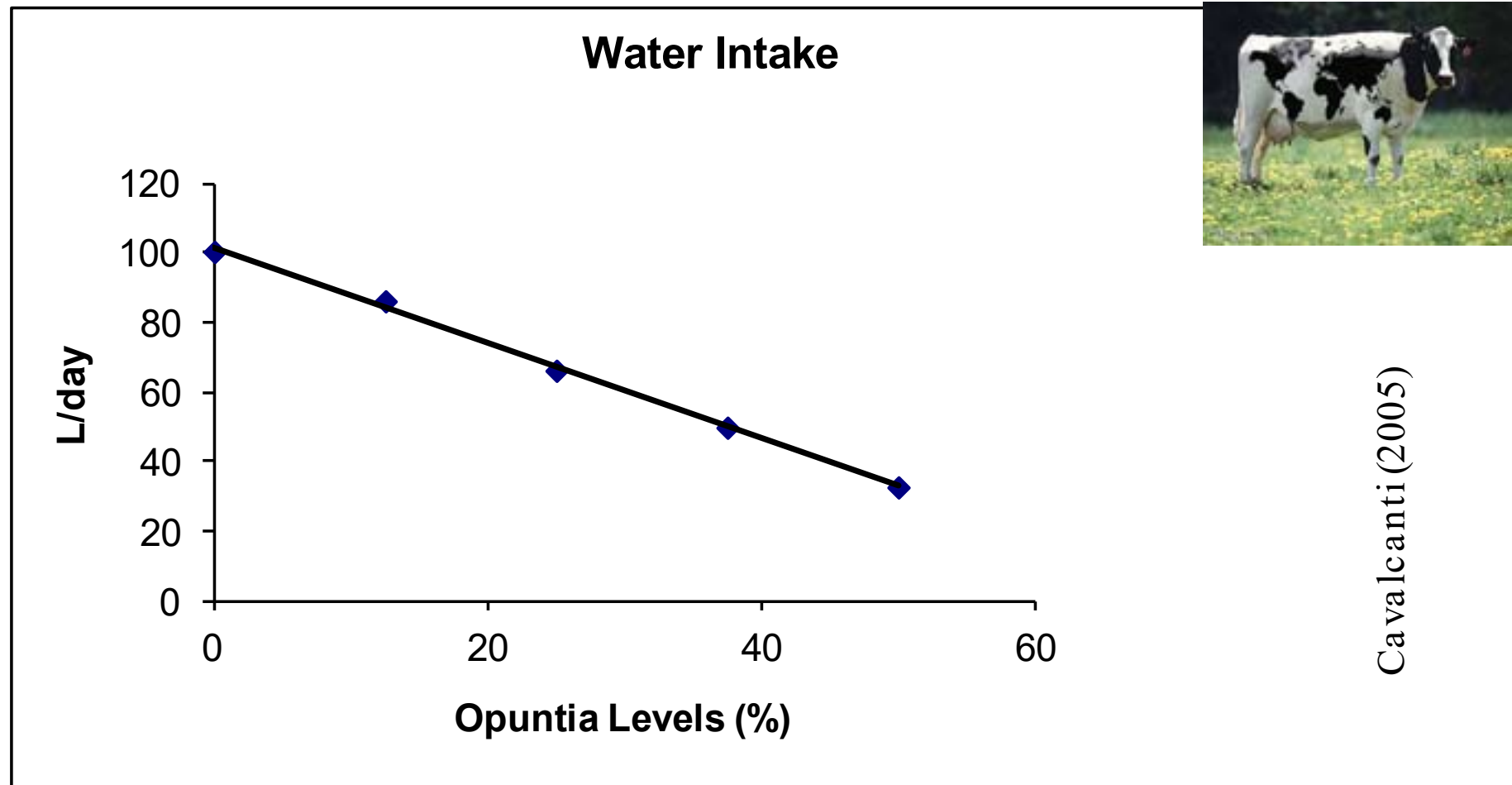
Item	(%)
Dry Matter	8 – 12
Crude Protein ¹	4 – 6
NDF ¹	28 – 30
ADF ¹	17 – 19
TDN ¹	65 - 70
NFC ¹	45 – 50
WSC ¹	14 – 16

Opuntia in replacement of Tifton hay – Dairy cows



Cavalcanti (2005)

Water intake by dairy cows



Opuntia in replacement of Tifton hay – Dairy cows

Animal performance



18 7 2006

Animal performance and dry matter intake by dairy cows fed cactus

Opuntia in the diet (% in DM)	Milk kg/d	Opuntia fresh intake (kg/d)	DMI %BW	Reference
61	12.1	106	3.4	Pessoa (2007)
41	17.8	66	2.8	Melo et al. (2003)
39	22.5	90	3.4	Pessoa et al. (2004)
50	20.5	81	3.3	Cavalcanti et al. (2008)

The pellet venture







ANIMAL FEED
CACTUS-BASED PELLETS
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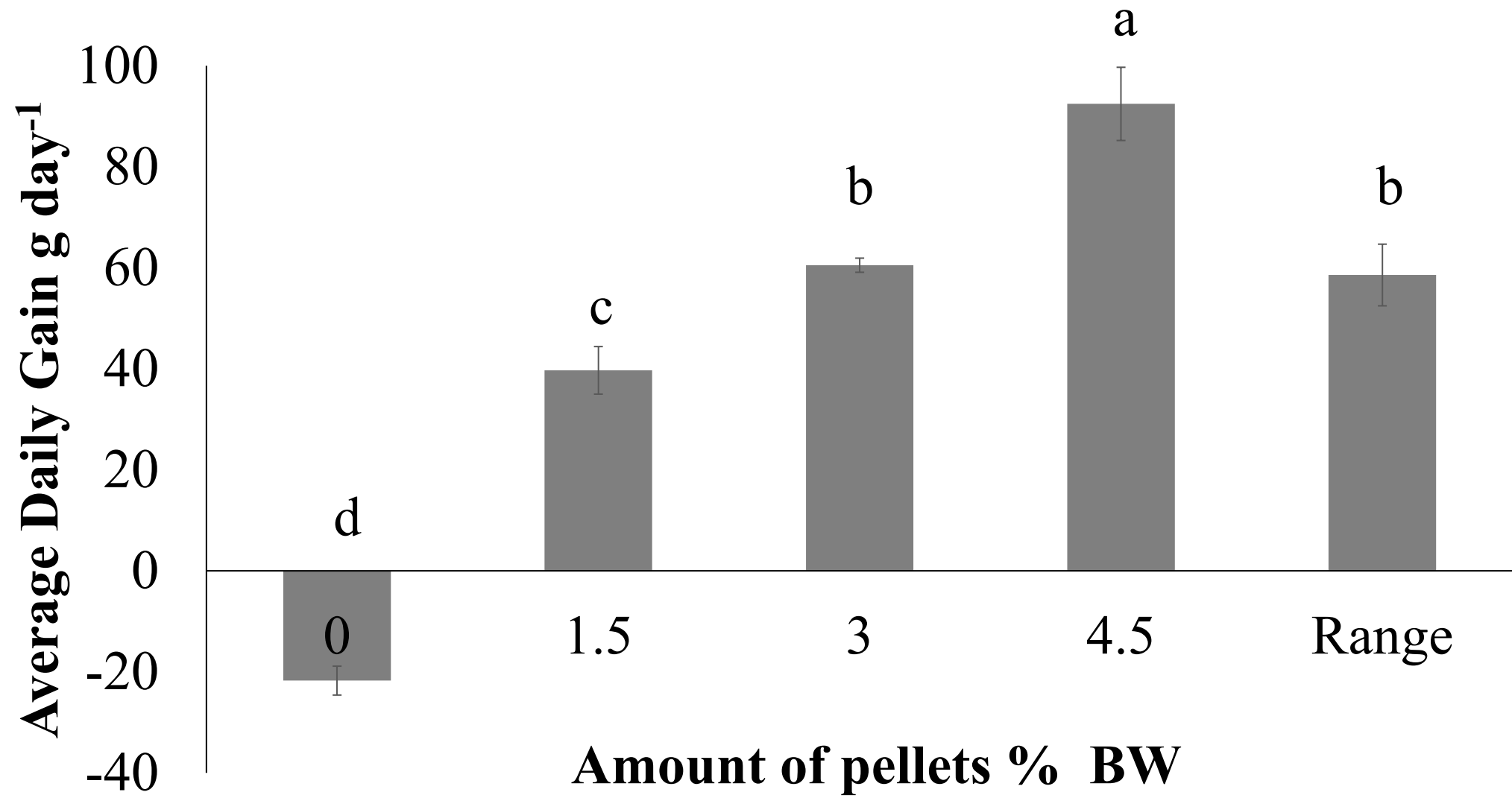


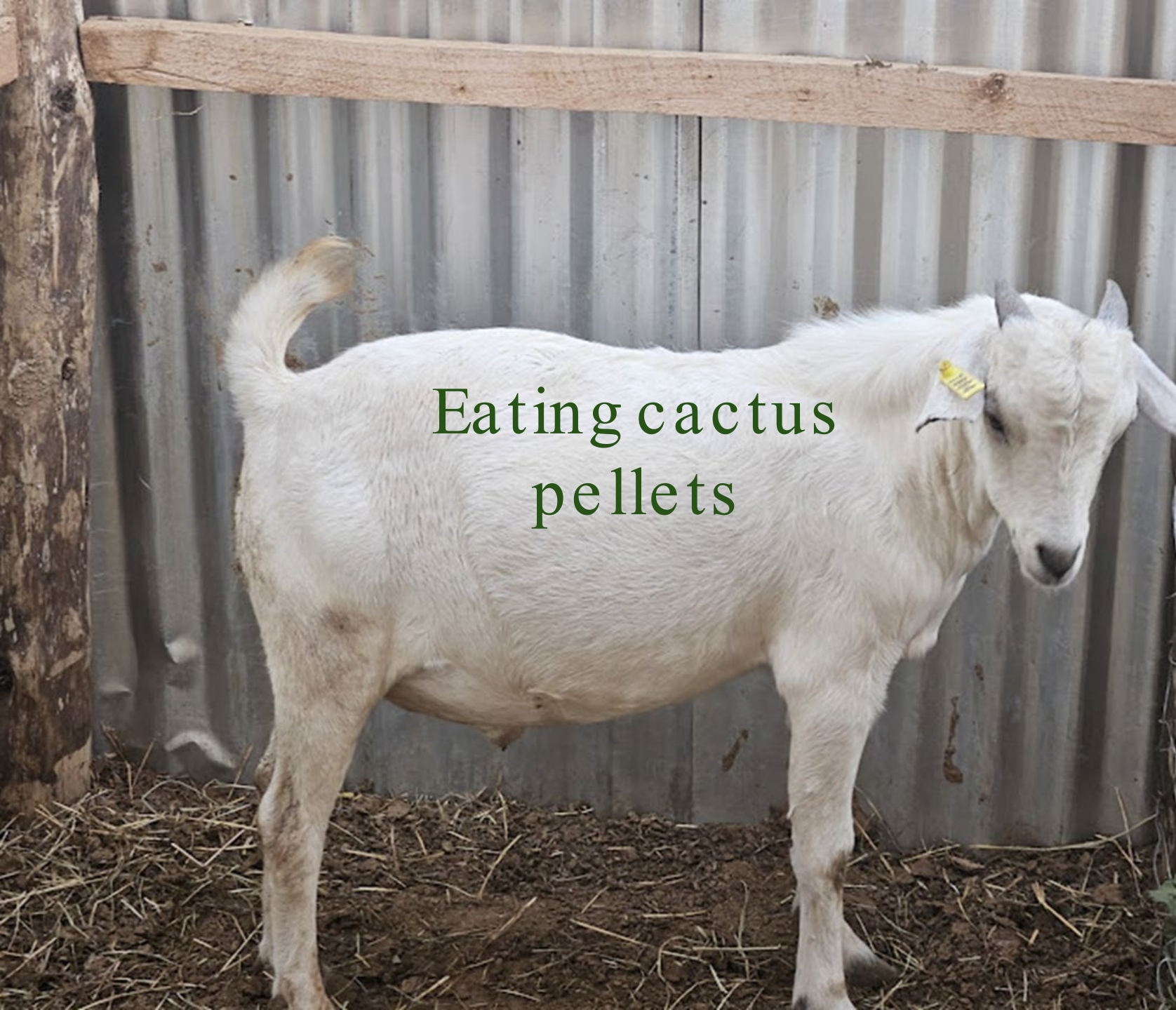


Treatments

1. Hay + 1.5%
 2. Hay + 3%
 3. Hay + 4.5%
 4. Hay only
 5. Grazing/browsing
- } pellets based on BW







Eating cactus
pellets



No cactus
pellets

Cactus silage

- Freeing the area for another crop
- Harvest mechanization
- Total mixed rations – TMR (Gusha et al., 2015)



Peculiar characteristics of cactus pear ensiling

- Cactus pH is around 4.0 to 5.0 (before ensiling)
- High presence of Weissella, which produce organic acids and enhance silage fermentation and aerobic stability (Soares et al., 2025)
- Cactus mucilage reduces losses and undesirable microorganisms, and also contains buffering acids that stabilize the pH and inhibit yeasts (Marte-Pereira et al., 2025)
- Combining with fiber and protein sources might improve silage quality (Brito et al., 2020)



Cactus silage physical aspect



Opuntia cochenillifera
cv. 'Miúda'



Opuntia cochenillifera
cv. 'IPASertânia'



Opuntia spp. cv.
'Mexican Elephant Ear'



Cactus pear (70%)
+Leucaena hay (30%)
silage

DM= 70 g kg⁻¹ NM

DM= 50 g kg⁻¹ NM

DM= 300 g kg⁻¹ NM

Fermentation profile of cactus pear silages

Parameter	Albuquerque et al. (2020)	Brito et al. (2020)	Matias et al. (2020)	Sá et al. (2020)	Sá et al. (2024)
pH	3.8	3.7	4.9	3.5	4.6
Buffer capacity (E.mg NaOH/ 100 g DM)	—	17	—	100	82
Effluent loss (kg/t fresh matter)	23	24	—	11	—
Gas loss (g/kg DM)	59	80	—	25	—
Dry matter recovery (g/kg)	923	966	941	964	678
N-NH ₃ (% total N)	1	1	5	0.1	6
Lactic acid (g/kg DM)	-	6	28.5	6.2	—
Acetic acid (g/kg DM)	-	1	6.0	16.3	—
Propionic acid (g/kg DM)	-	0.1	4.8	0.32	—
Butyric acid (g/kg DM)	-	0.01	9.3	0.34	—

Note: (–) Data not reported by the author; DM: dry matter.

Animal performance on cactus pear silages

Silage Composition	Animal	ADG (g/day)**	Reference
67% Cactus + 33% <i>Leucaena leucocephala</i>	Goat	95a	Gusha et al. (2015) ¹
67% Cactus + 33% <i>Acacia angustissima</i>		82a	
67% Cactus + 33% <i>Calliandra calothyrsus</i>		36b	
67% Cactus + 33% <i>M. atropurpureum</i>		0b	
Elephant grass		-64c	
Tifton hay	Goat	63a	Albuquerque et al. (2020) ²
21% cactus*		74a	
42% cactus*		79a	
Tifton hay	Lamb	142b	Nobre et al. (2023) ²
21% cactus*		184a	
42% cactus*		208a	
100% cactus	Lamb	293a	Silva et al. (2021) ^{2, 3}
70% cactus pear + 30% buffel grass		232b	
70% cactus pear + 30% <i>Gliricidia sepium</i>		303a	
70% cactus pear + 30% <i>Manihot</i> sp.		279ab	
100% corn		234b	



* Replacing Tifton hay.

**Means followed by the same letter do not differ by Tukey's test ($p < 0.05$). ¹Roughage only (silage + elephant grass); ²Roughage:concentrate ratio of 60:40; ³Roughage:concentrate ratio of 38:62 using wheat bran as fiber source in 100% cactus silage.'

Strategies for using cactus silage

- Forage component in total mixed ration (TMR) silages (Macedo et al., 2018)
- Additive for rehydrating corn grain for silage (Soares et al., 2025)
- Relocation or re-ensiling, facilitating transport and commercialization of silage (Silva et al., 2025)



Final Considerations



- Cactus will have an increasing role as animal feed in the years to come considering the current scenario of extreme weather events and increasing temperatures
- Cactus must be fed with other ingredients in a diet, and it is not a complete feed source
- Multiple uses of cactus allow flexibility in its management, adapting to different scenarios

Thank you!
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