Dipartimento
Medicina Veterinaria
Produzioni Animali

PLF

UNIVERSITÀ
DEGLI STUDI DI NAPOLI
FEDERICO II

Hydroponics in Livestock Farming

From seed to plant in 6 days.

ὕδωρ hýdor, **water** + πόνος pónos, **work**

"Water that works"

Throughout the years

Hanging Gardens of Babylon

Sixth century B.C.

William Frederick Gericke

The first commercial application (1920)

The off-soil cultivation is used for the large-scale production of fresh vegetables and ornamental plants

Thanks to the improvement of irrigation systems, the use and spread of inert substrates and the availability of innovative mixing and control systems

Off-soil crops

without substrate

Characterized by closed cycle systems

on substrate

Can be closed cycle systems or open

Benefits

Continuous production

Daily production and collection of food rations, cancelling almost all the waiting periods valid to produce fodder in conventional agriculture, for a total of 360 harvests per year.

Hectares in few square meters

It replaces 500 hectares of farmland, with nearly 16 tons of forage produced daily.

Zero waste

Hydroponic cultivations use on average 90% less water than traditional centralized irrigation systems. Feed ration is fully ingested by the animals removing waste.

Benefits

Climatic indipendence

All internal environmental conditions, such as humidity, air and temperature are kept under control and stable allowing a constant growth of the shoots despite any adverse climatic conditions.

Reduce managing costs

Minimal farm equipment is needed. Indoor seeding of hydroponic foods is more profitable than conventional systems and safer for food without the need of fertilizers, chemicals and pesticides.

Superfeed and animal wellness

Germination and early growth of plants improve nutrients and hydrolytic enzymes, providing the digestibility of any feed on the farm. This means that the animal consumes less dry matter to achieve the same results.

Disadvantages

High costs of the system

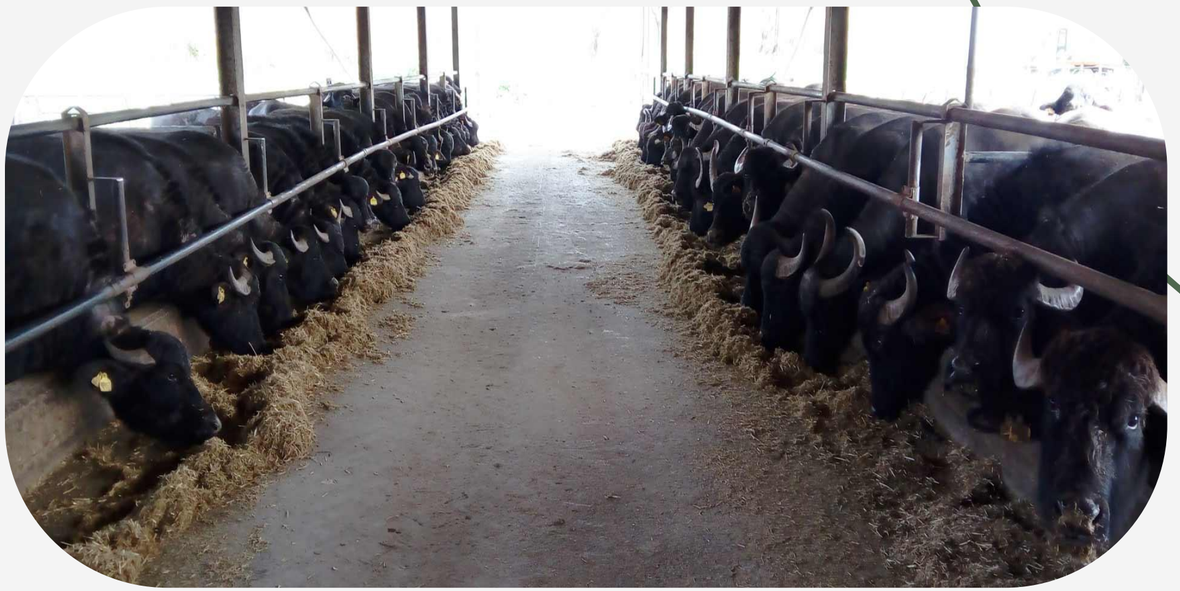
Increased use of materials difficult to recycle

Good quality water

Disposal of drained solutions not completely exhausted

MASSERIA CILENTANA

produzione propria di latte di bufala



cubicfarm SYSTEMS CORP.

hydrogreen

A new way to feed our world

A fully **automated, modular indoor HYDROPONIC** culture system that sustainably and consistently produces highly nutritious and digestible feeds while reducing greenhouse gas and using 90% less water in just **6 DAYS**

HydroGreen Vertical PasturesTM

- From 6 to 12 Modules
- Indoor scale cropland
- Climate controlled
- High yealds for each level

How it works?

SEEDING

WATERING

HARVESTING

All access with One Touch

- USER FRIENDLY DIGITAL PANEL
- INDIVIDUAL LEVEL MANAGEMENT
- SELF CLEANING ROUTINE

Hydroponic Fodder

Dry Matter and Organic Matter content

Due to low starch content during first days of germination

Total Protein content

Due to high metabolic activity

Total Ethere Extract

Due to high production of structural fatty acids and cellulose

Total Ash content

Due to high absortion capacity of the growing roots

Effect of feeding of hydroponics fodder on intake and digestibility of nutrients

Parameter	Hydroponics fodder	
	No	Yes
Feed intake		
Fresh intake (kg/d)	--	50.38
DM intake (kg/d)	7.20-9.70	6.60-8.85
DM intake/100 kg BW (kg)	2.17-2.84	2.05-2.74
Roughage: concentrate ratio	63: 37	65: 35
Digestibility (%)		
DM	60.34-61.15	64.48-65.53
OM	61.89-64.19	65.98 -68.47
CP	61.89-68.86	66.77-72.46
EE	69.92-82.05	77.60-87.69
CF	47.93-53.25	54.85-59.21
NFE	65.84-67.37	68.13-70.47
Nutritive value (%)		
DCP	6.89-8.61	7.82-9.65
TDN	55.43-64.00	61.19-73.12
NR	--	6.72
Nutrient intake (kg/d)		
CP intake (kg/d)	--	0.97
DCP intake (kg/d)	--	0.67
TDN intake (kg/d)	--	5.20

Review-Production and Utilisation of Hydroponics Fodder. Naik *et al.* 2015

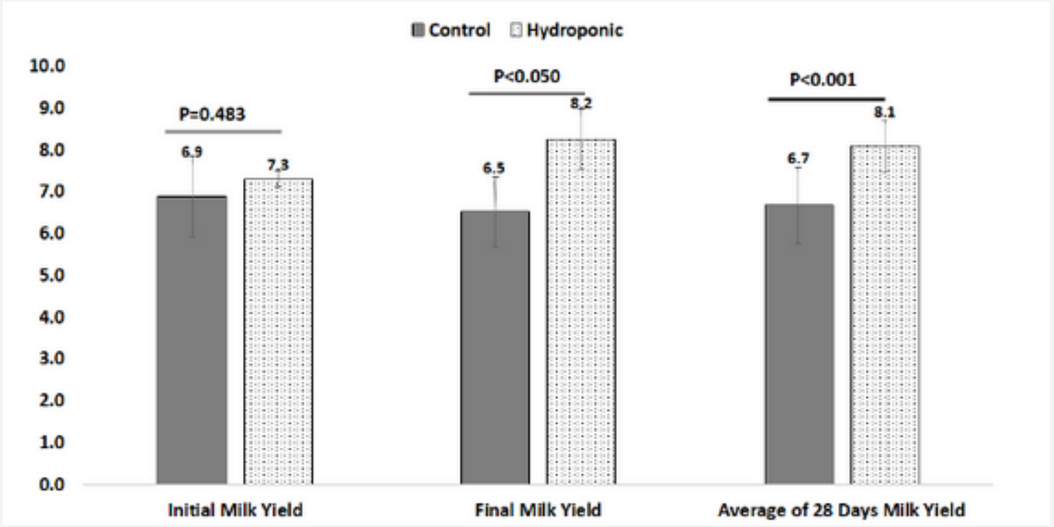
Milk Production

Average and Total milk Yealds

Due to high global digestibility of the fodder

+ 1.5 kg on average day milk produced

Comparison of initial, final and average milk yield of control and hydroponic fed cows



Partial Replacement of Conventional Concentrate Mixture with Hydroponic Maize and Its Effect on Milk Production and Quality of Crossbred Cow (Bari *et al. 2020)*

Parameters	Diets (mean ± SD) Control (n = 3)	Hydroponic (n = 3)	p-value
Chemical constituents (g kg^{-1})			
Total solids	127.62 ± 0.88	129.66 ± 1.01	<0.001
Fat	42.88 ± 0.65	44.46 ± 1.60	0.004
Solids-not-fat	84.74 ± 1.51	85.10 ± 1.41	0.554
Protein	32.04 ± 0.68	32.08 ± 0.45	0.889
Lactose	46.19 ± 0.89	46.35 ± 0.90	0.668
Ash	6.54 ± 0.15	6.81 ± 0.14	0.008

Influence of partial replacement of concentrate mixture by HMF on milk attributes

- Total solid fraction (+2%)
- Total Fat content (+4%)
- Total Ashes content (+8%)

(Bari *et al. 2020)*

Productive Benefits

Ingested fodder

The amount of overall ingested dry matter is significantly lower (-21% DMI)

Better Feed Conversion Efficiency

Cows fed with Hydroponic fodder resulted more efficient in feed conversion processes

= Amount of milk produced per day

It is therefore sufficient a smaller amount of fodder to ensure the same productive energy needed to produce 1 kg of milk

Influence of partial replacement of concentrate mixture by HMF on DMI, body weight, FCE and milk attributes

Parameters	Diets (mean ± SD) Control (n = 3)	Hydroponic (n = 3)
Average DMI (kg $d^{-1}cow^{-1}$)	10.69 ± 0.19	10.06 ± 0.17
Average DMI/100 kg BW (kg)	3.18 ± 0.15	3.03 ± 0.02
Average BW (kg cow^{-1})	343.0 ± 19.3	339.0 ± 8.54
Feed conversion efficiency (FCE)		
Kg DMI/kg milk yield	1.63 ± 0.28	1.25 ± 0.11
Kg TDNI/kg milk yield	0.97 ± 0.17	0.76 ± 0.07

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Other effects from "grass juice factors"

- General fertility and Conception rates
- Better immune system development
- Overall health conditions

Hydroponics fodder production: an alternative technology for sustainable livestock production against impeding climate change (Naik *et al. 2013)*

For the environment:

Minimum use of primary resources and an increasingly **sustainable production**

For the animal:

Improves the **health status** of the animal **without reducing productivity**.

For the future

Research objectives:

Detailed analysis of the overall chemical composition of milk

Benefits and improvements in the reproductive performance of animals

Use of other forage varieties and the quality of the hydroponic forage they produce

Effects of hydroponic fodder on meat animals

Thanks!

For the attention

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