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Session 82 - Calvana room



CAROB GERM: AN ALTERNATIVE PROTEIN SOURCE IN FEEDING LAMB

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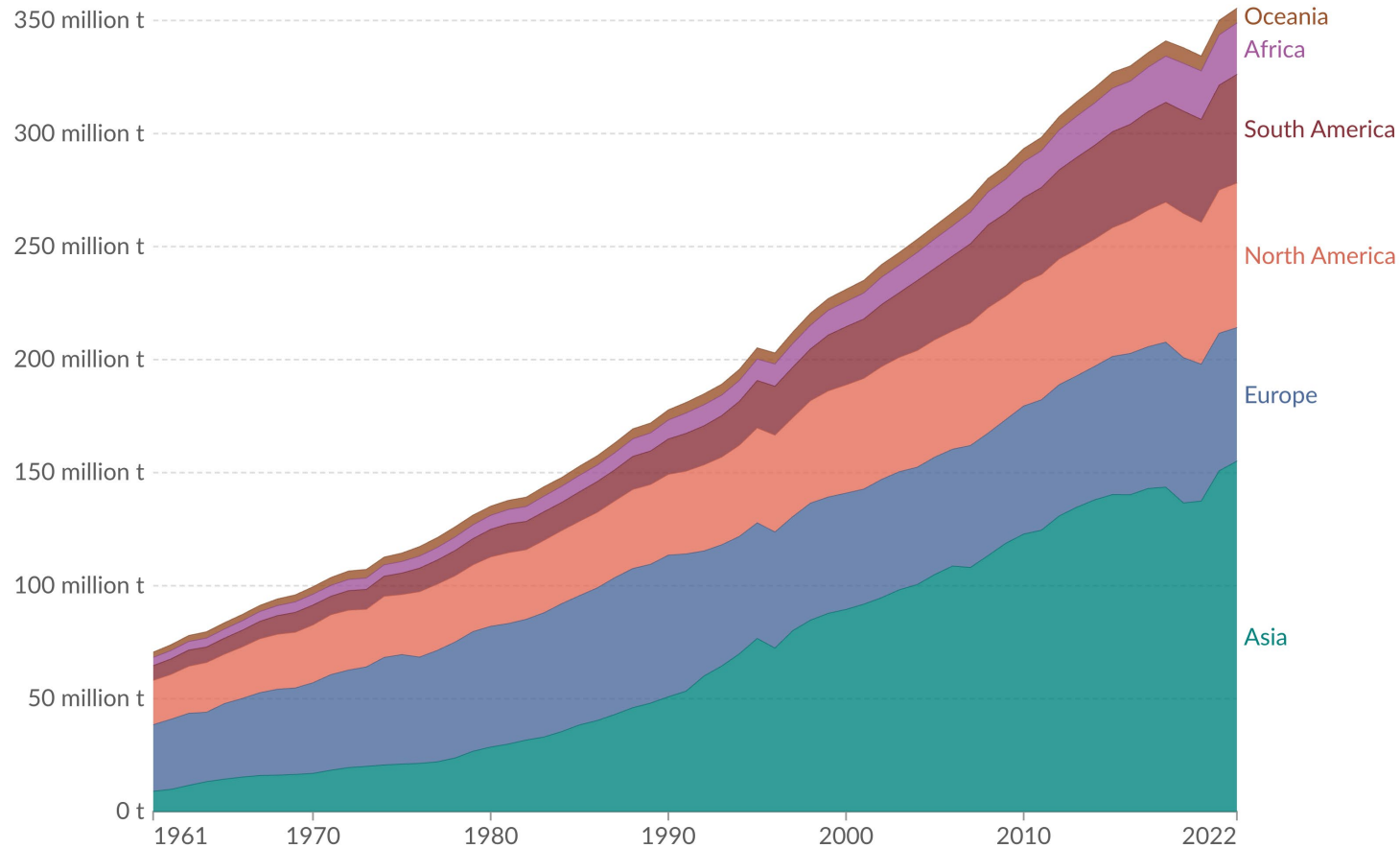


INTRODUCTION

The increase in world population and eating habits require sufficient meat production

Global meat production, 1961 to 2022

Our World
in Data

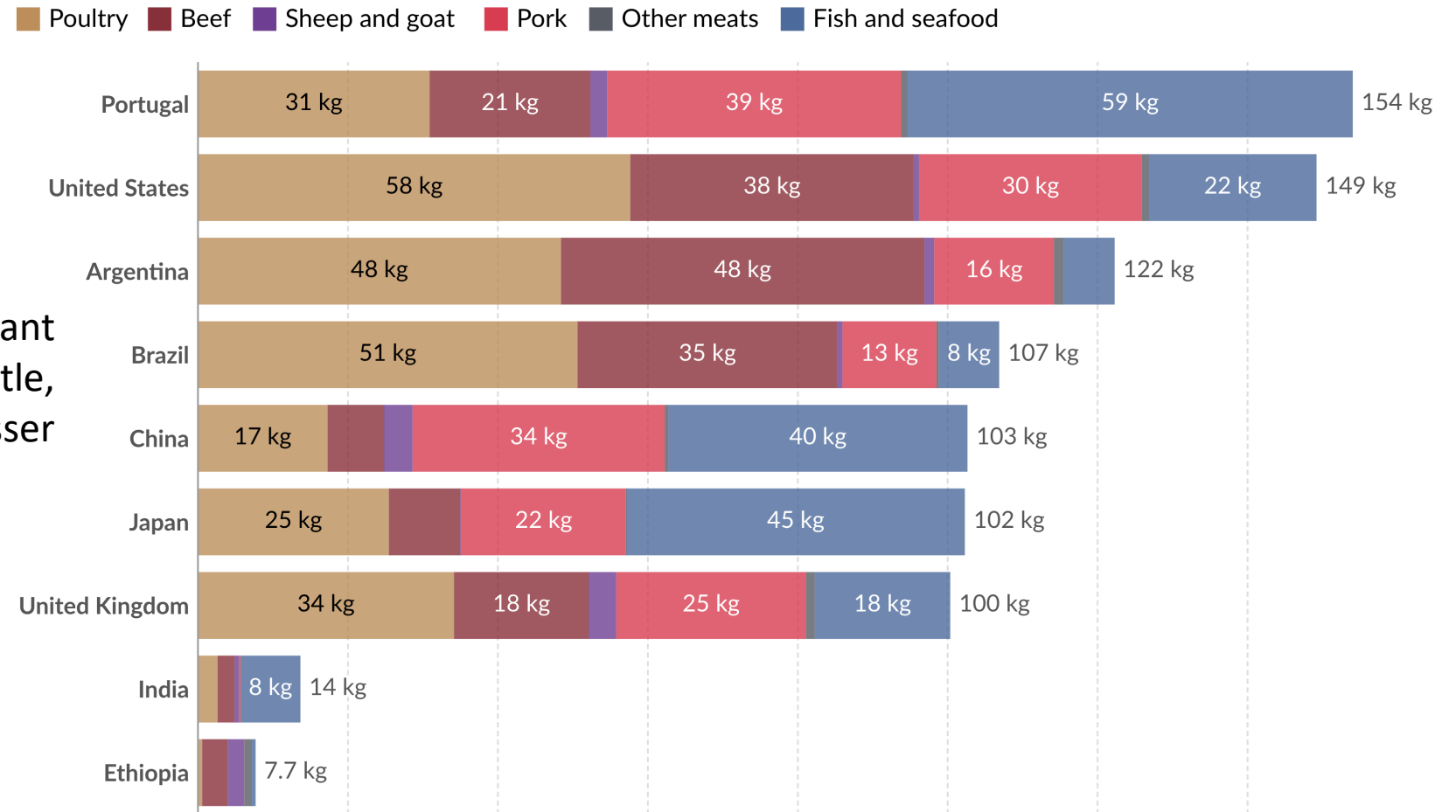


Data source: Food and Agriculture Organization of the United Nations (2023)

OurWorldInData.org/meat-production | CC BY

INTRODUCTION

Per capita meat consumption by type, 2021



At a global level, the dominant livestock types are poultry, cattle, pigs, and sheep & goats to a lesser extent.

Data source: Food and Agriculture Organization of the United Nations (2023)

OurWorldInData.org/meat-production | CC BY

Note: Data refers to meat 'available for consumption'. Actual consumption may be lower after correction for food wastage.

INTRODUCTION

To satisfy meat production and to obtain **huge** quantities, we are forced to **import feedstuff**



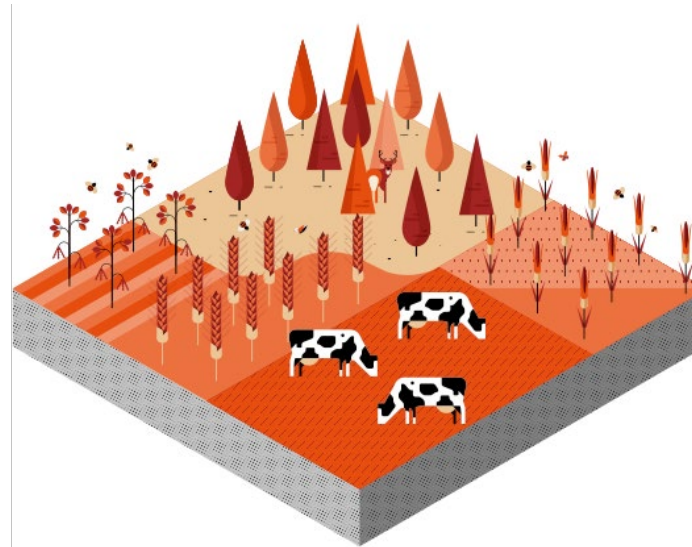
Why alternative feeds?



Costs increase



Competition



Soil degradation

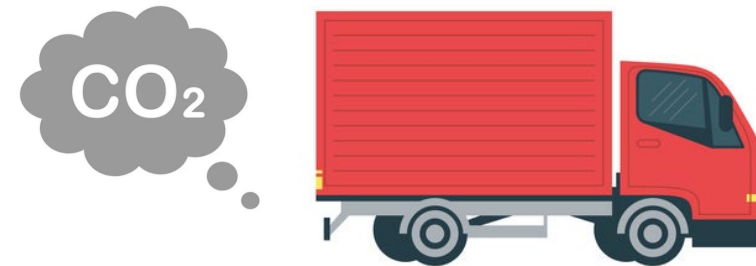
Why alternative feeds?



Loss of Biodiversity



Deforestation



Transport Emission

Possible solutions



ALTERNATIVE **LOCAL** RESOURCES:

- Cheap and widely available
- Good nutritional value
- Still edible for ruminant

Vasta et al. 2008. *An. Feed Sc. and Tech.* 147(1-3), 223-246. <https://doi.org/10.1016/j.anifeedsci.2007.09.020>

Carob



The **carob** tree (*Ceratonia siliqua* L.), belonging to the *Fabaceae* family of the order Fabales, is a long-living evergreen and thermophilous arboreal species, adapted to different soil and salinity conditions and commonly found in Mediterranean areas

Gugliuzzo et al. *Phytoparasitica* 47, 605–628 (2019). <https://doi.org/10.1007/s12600-019-00766-7>

Obeidat et al. 2012. *Small Rumin. Res.* 105(1-3), 9-15. <https://doi.org/10.1016/j.smallrumres.2012.01.001>

Carob

The tree produces edible fruits, known as pods or merely **carobs**



Amar et al. 2024. Eur. J. Lipid Sci. Technol. e2400036. <https://doi.org/10.1002/ejlt.202400036>

Average carob production and total sums of the nine major producing countries during 2013- 2019

Producing country	Average (tons)	Sum (tons)
Spain*	44,283	265,700
Portugal*	44,214	265,284
Italy	29,025	203,175
Morocco	21,790	152,707
Turkey	14,469	101,280
Greece*	12,912	129,116
Cyprus	7,769	54,380
Lebanon	3,589	25,124
Algeria	3,577	25, 037

@FAOSTAT, 2021

Bulca S. 2016. Sci Bull Ser F Biotechnol. 20:142–147.

Tzatzani & Ouzounidou 2023. *J. Innov. Econ. Manag.* 42, 127-147. <https://doi.org/10.3917/jie.pr1.0140>

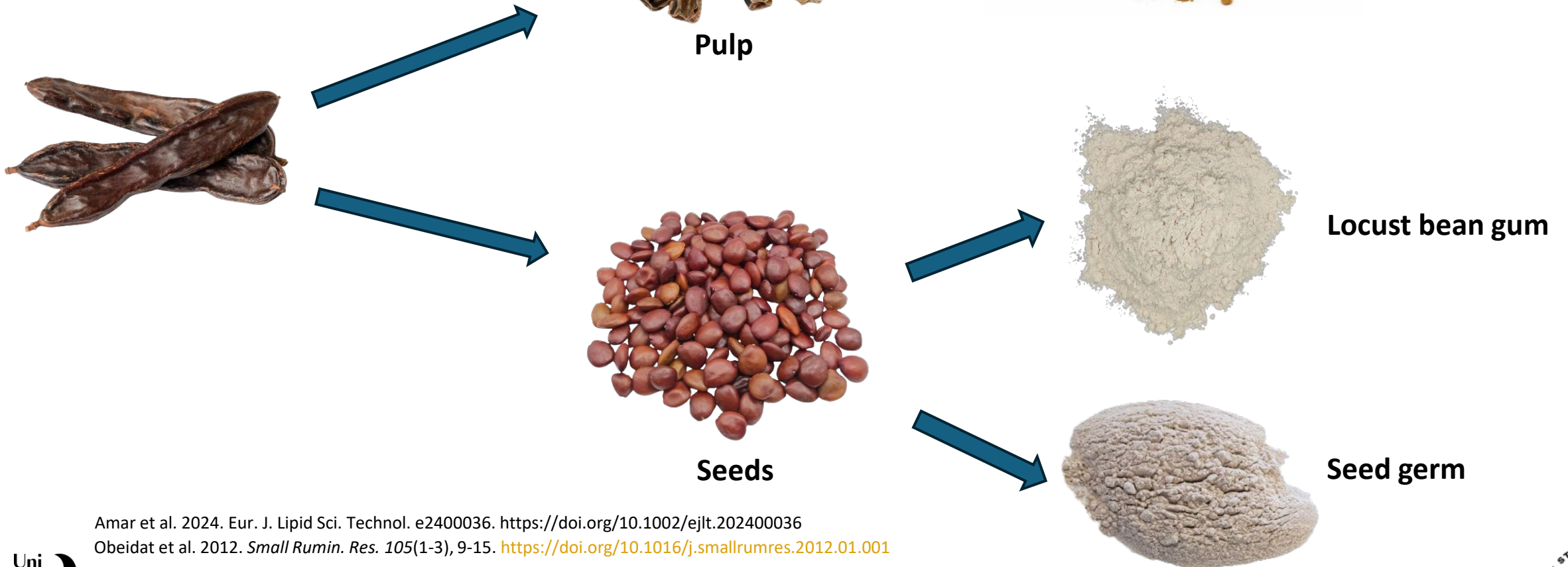


In Italy, carob cultivation is prevalent in South-eastern Sicily, where it has represented an important economic resource for centuries.



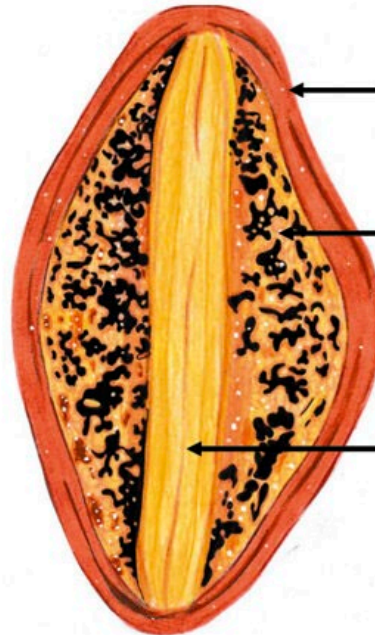
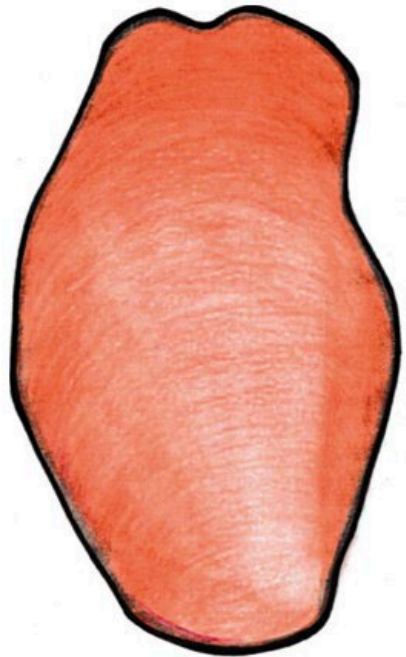
INTRODUCTION

Carob parts



Amar et al. 2024. *Eur. J. Lipid Sci. Technol.* e2400036. <https://doi.org/10.1002/ejlt.202400036>
 Obeidat et al. 2012. *Small Rumin. Res.* 105(1-3), 9-15. <https://doi.org/10.1016/j.smallrumres.2012.01.001>

Carob seed



Seed peel (30 to 33%)

Endosperm (42 to 46%)

Germ (23 to 25%)



Laaraj et al. 2023. J. Food Qual. 3438179. <https://doi.org/10.1155/2023/3438179>

Carob germ meal



Chemical composition, g/kg DM

Dry Matter (DM), g/kg as fed 949

Crude Protein 261

NDF 318

ADF 183

ADL 297

Ash 139

Extract Ether 23.6

Total Phenols, mg TANEq/g DM 39.2

Total Tannins, mg TANEq/g DM 33.1

Fatty acids, %

C16:0 16.85

C18:0 4.26

C18:1 c9 33.59

C18:2 n-6 41.61

C18:3 n-3 1.47

Vitamins, ug/g DM

α-Tocopherol <0.001

γ-Tocopherol 0.45

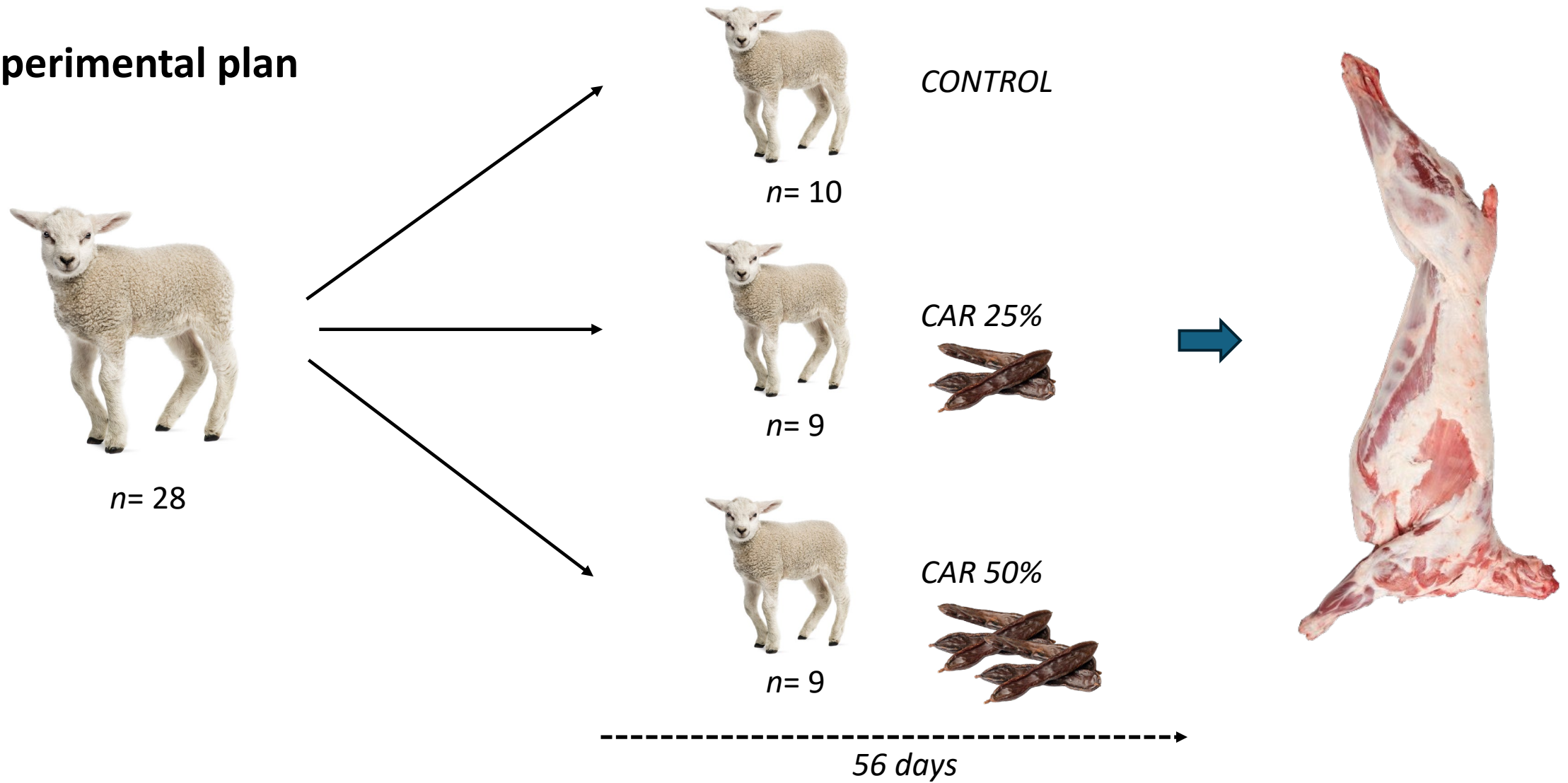
Aim of the study



Assessing the effects of including carob germ in lambs' diet on animal performances and meat quality.

MATERIAL & METHODS

Experimental plan



Animal diets



Item	Diet		
	Control	CAR 25%	CAR 50%
<i>Chemical composition, g/kg DM</i>			
Dry Matter (DM), g/kg as fed	907	919	930
Crude Protein	197	190	181
NDF	218	272	300
ADF	154	184	213
ADL	176	89	103
Ash	80	139	133
Extract Ether	19.5	22.1	24.7
Total Phenols, mg TANeq/g DM	5.96	13.9	23.2
Total Tannins, mg TANeq/g DM	1.72	9.22	17.5
<i>Fatty acids, %</i>			
C16:0	21.30	19.69	17.85
C18:0	7.09	5.78	3.90
C18:1 c9	23	26.56	26.67
C18:2 n-6	41.19	42.41	43.55
C18:3 n-3	5.83	5.55	5.94
<i>Vitamins, ug/g DM</i>			
α-Tocopherol	8.67	8.12	7.18
γ-Tocopherol	16.6	11.9	10.1

Analysis

Drip loss



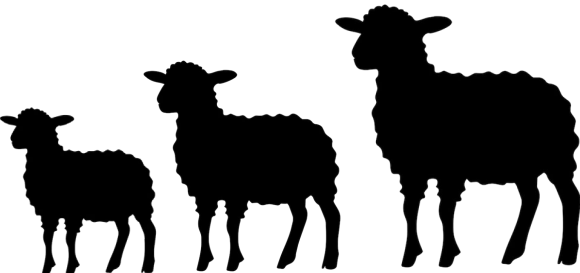
Color



Antioxidant Capacity



Animal performance



	Dietary Treatments			<i>p-value</i>
	Control	CAR 25%	CAR 50%	
<i>Growth performance</i>				
DMI, g/d	868.3	955.5	930.5	0.555
CPI, g/d	183.3	165	173	0.472
ADG, g/d	231.9	240.0	251.5	0.727
Final BW, kg	26.2	27.1	25.8	0.732
FCR, g DMI / g ADG	4.0	3.8	3.8	0.643
<i>Carcass traits</i>				
Hot carcass, kg	11.4	11.7	12.1	0.692
Cold carcass, kg	11.2	11.5	12.0	0.674
Chilling lose, %	1.8	1.7	1.5	0.661
Meat pH (24h)	5.8	5.9	5.9	0.749

Meat color

Control



L^* 45.8
 a^* 13.7
 b^* 11.7
 C^* 18.0



CAR 25%



L^* 46.0
 a^* 13.5
 b^* 12.0
 C^* 18.1



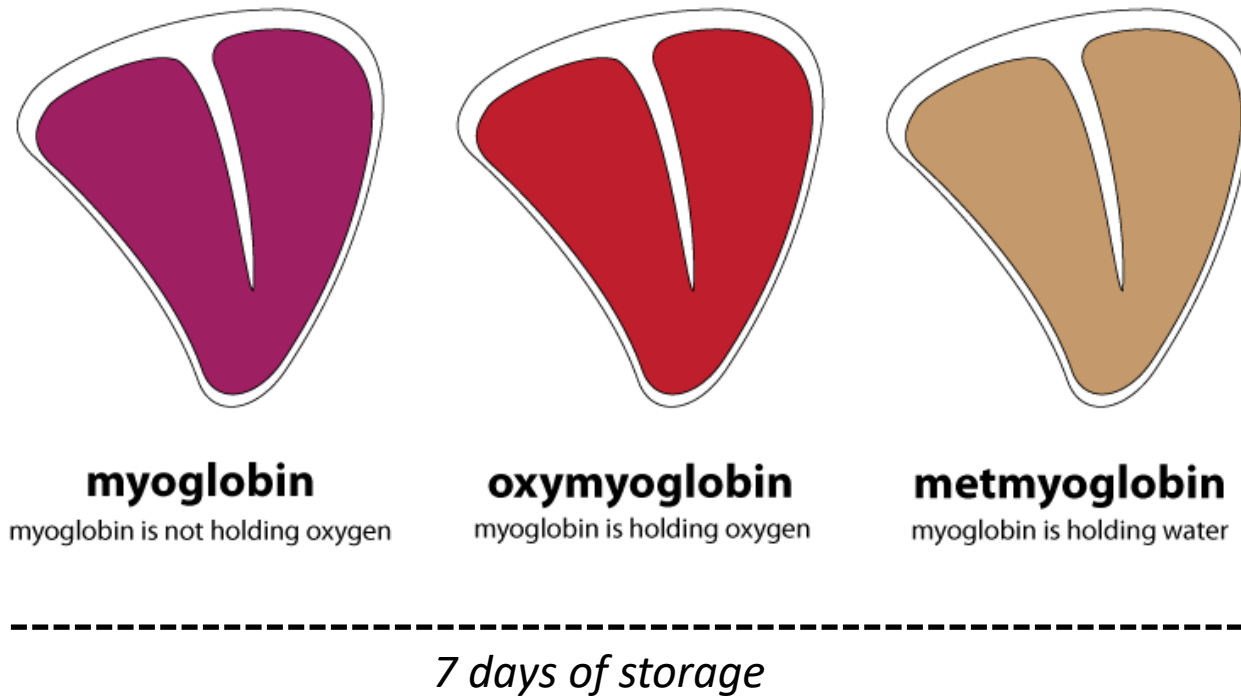
CAR 50%



L^* 46.0
 a^* 13.4
 b^* 12.4
 C^* 18.3



Meat color

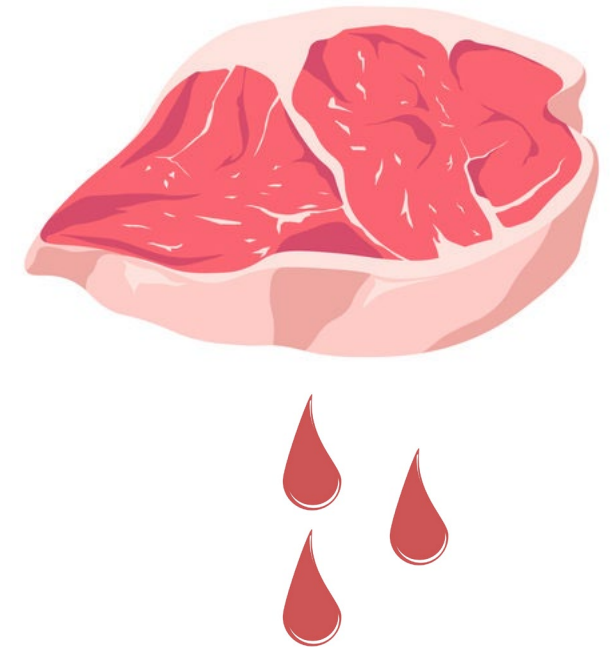
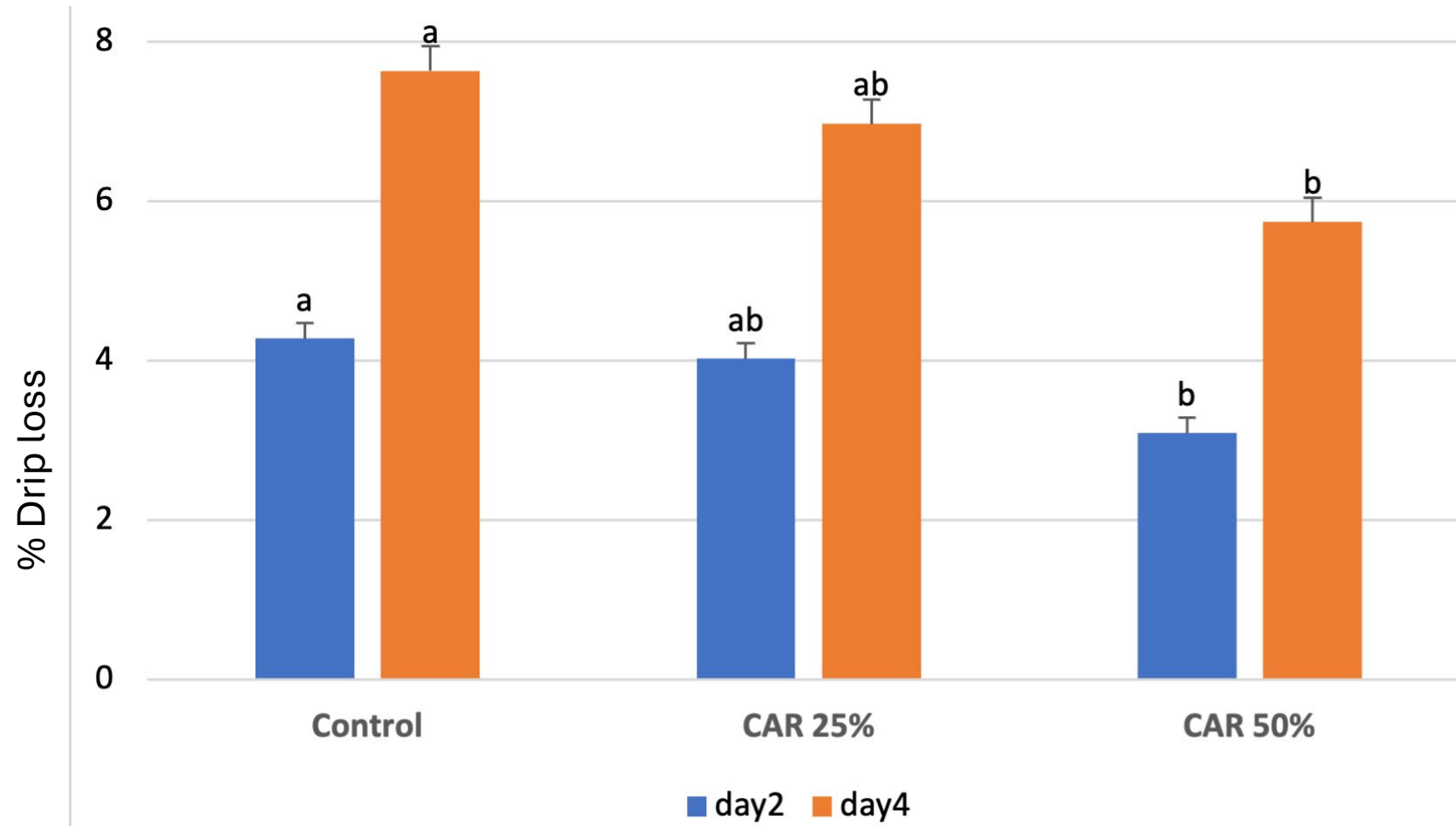


MetMb, % of Mb

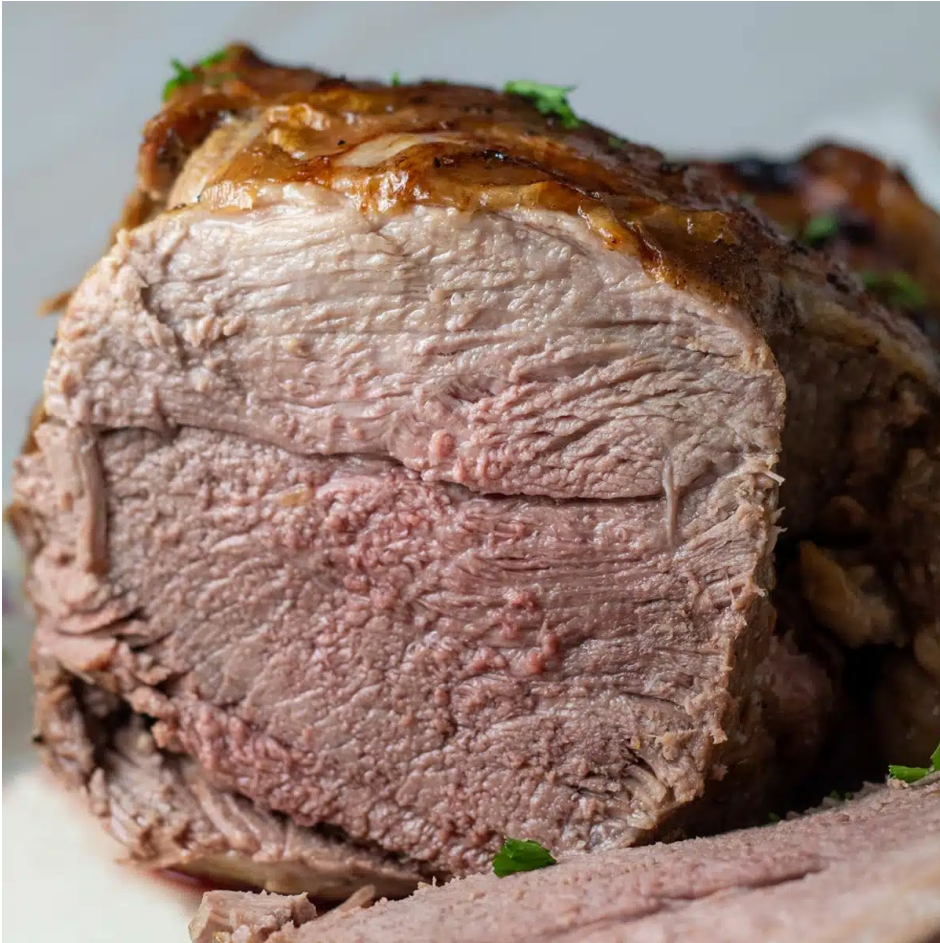
Control	CAR 25%	Car 50%	<i>p-value</i>
49.58	51.16	52.80	0.359

Lack of effectiveness of dietary Carob Seed Germ in possible delaying meat discoloration.

Drip loss



Drip loss



...may contribute to improve **tenderness** and **juiciness** in lamb meat



Antioxidant activity



Item	Dietary treatment			SEM	<i>P-value</i>
	Control	CAR 25%	CAR 50%		
Hydrophilic antx. Cap. (mg/g)					
TEAC (Trolox eq)	27.2	34.8	27.1	4.174	0.343
FRAP (Fe2+ eq)	18.5	17.4	19.1	0.760	0.287
Folin-Ciocalteu (TANeq)	0.632	0.585	0.596	0.023	0.348

Feeding lambs with **carob** germ could be an effective strategy to reduce the cost of ruminant diet



Further analyses are ongoing to assess the effect of dietary **carob** germ on important quality traits of meat

THANK YOU!



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Uni
ct

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ALIMENTAZIONE
E AMBIENTE

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75° EAAP Annual Meeting
Florence - Italy

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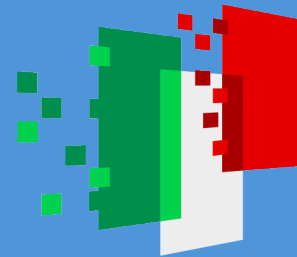
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PIANO NAZIONALE
DI RIPRESA E RESILIENZA