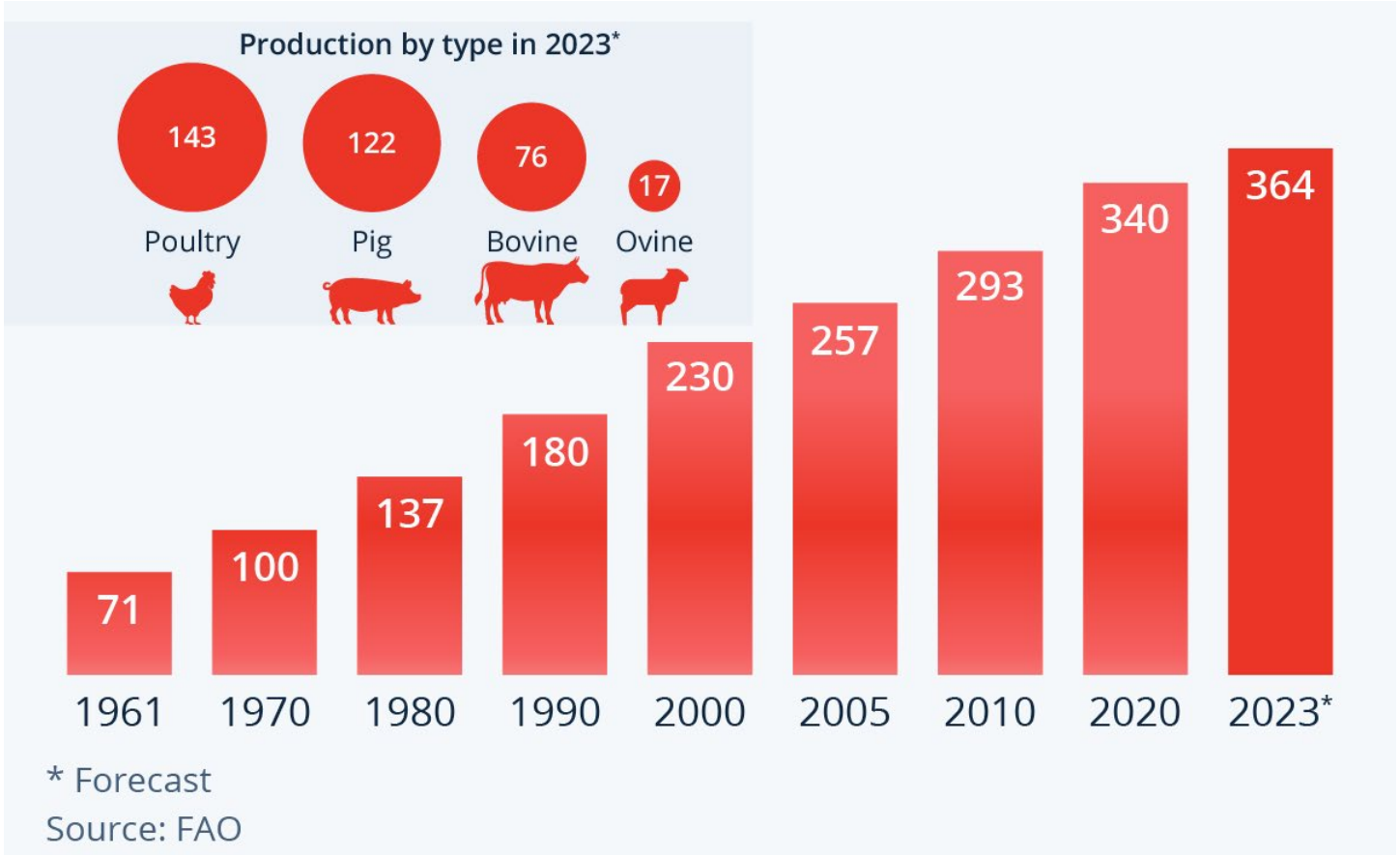
Total replacement of soybean meal with lupine seed in lamb diet: Effects on growth performance

Musati M., Mangano F., Bertino A., Luciano G., Biondi L., Cannone M.S., Mangione G., Natalello A., Lanza M.

75th EAAP Annual Meeting
September 4th, Florence – Italy

Introduction

Global meat production in million tons

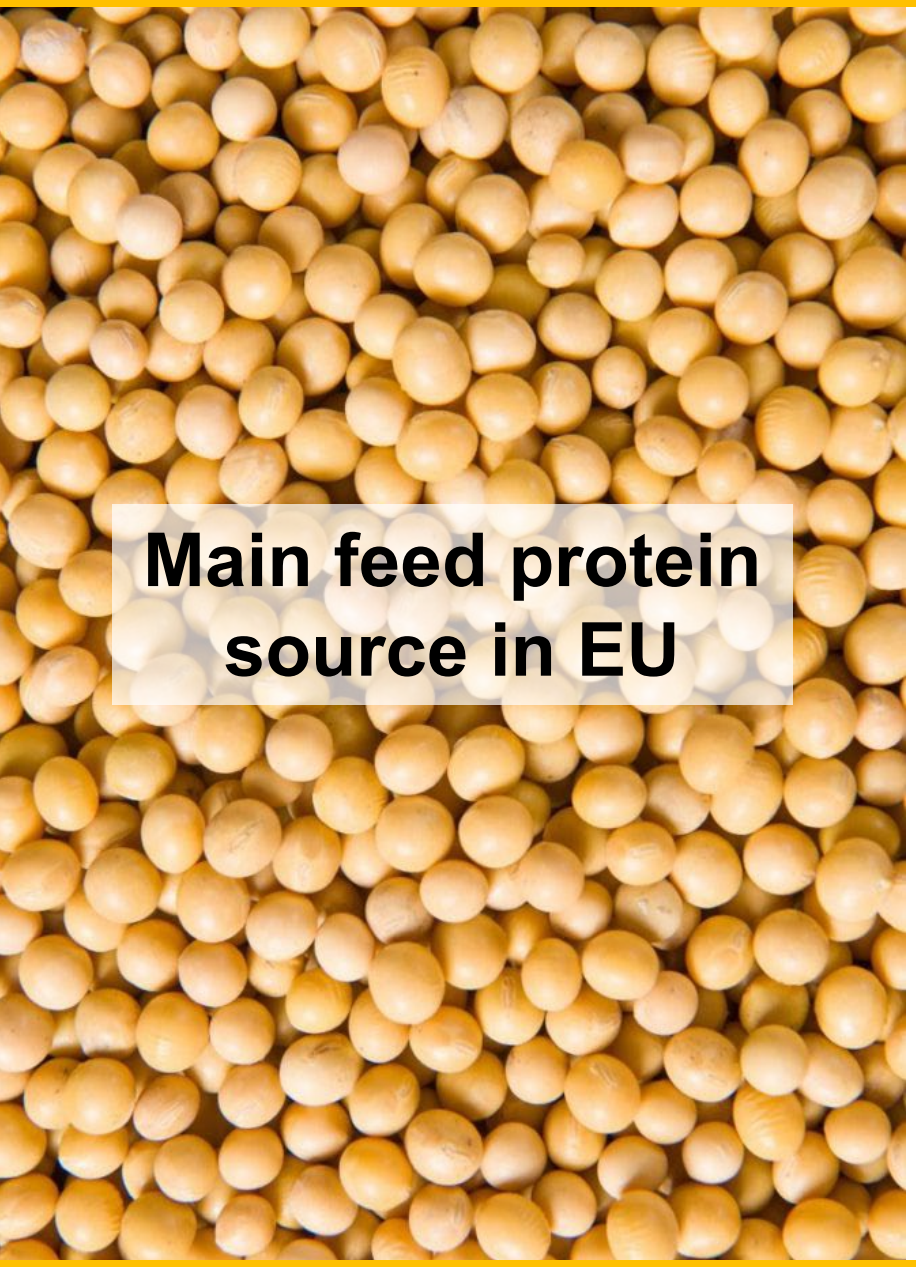


Estimated global population

9.8 Bn
in **2050**

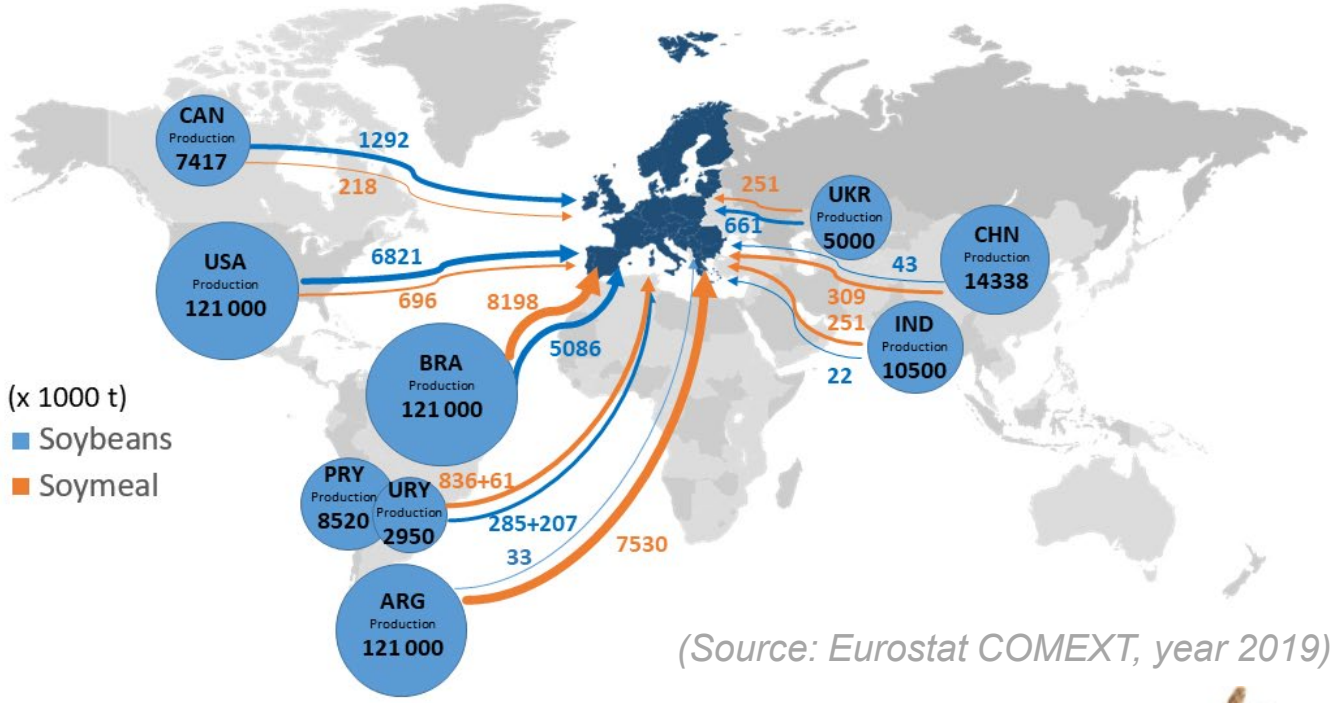
Find protein sources for animal production

Introduction



Main feed protein source in EU

Soybeans and soybean meal trade flows into EU



(Source: Eurostat COMEXT, year 2019)

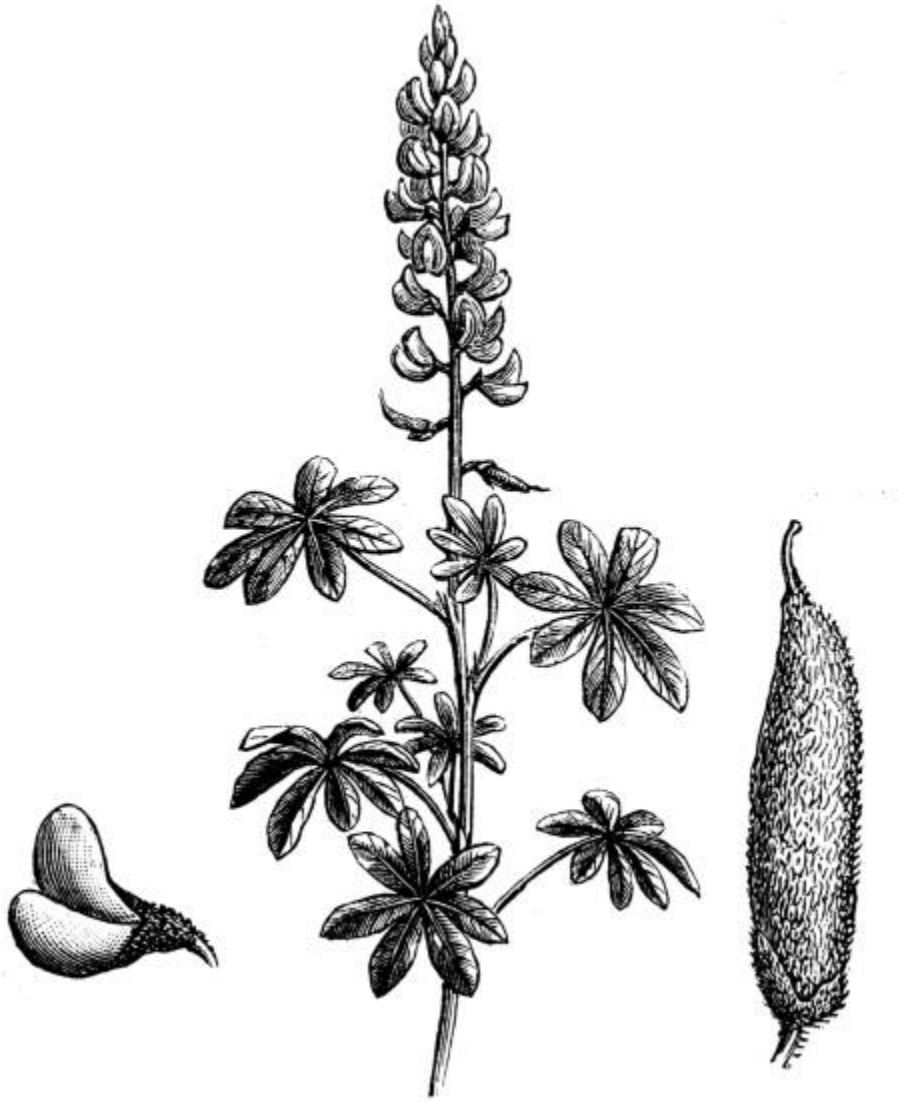
New local alternative feed

Introduction

New local alternative feed :

- Reduce cost
- Prevent price fluctuation

- Decrease environmental impact for transportation



Introduction

Lupinus albus (L.)

Characteristics:

Belonging to the *Fabaceae* family

Cultivated in the Mediterranean region

1.6 Mn tons in 2022 (59% Australia, 22% Poland)

Uses:

Animal nutrition as integrator

Human nutrition as “snack”

Fertilizer as green manure

Introduction

Lupinus albus (L.)

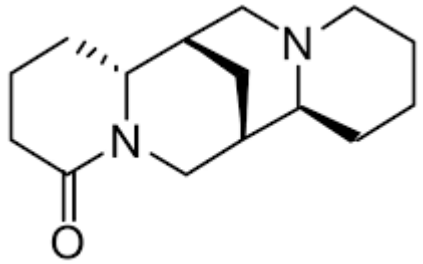
mg/kg DM	Lupine seed	Soybean meal
DM	858	893
Ash	53.2	64.8
Crude protein	405	471
Crude fat	42.1	14.0
NDF	410	181

Sami et al., 2010

< protein

> fibre

> lipids



"**Sweet**" lupine
poor in **alkaloids**

Lupanine
Hidroxilupanine
Sparteine
Angustifoline

Aim of the study

Substitution of soybean meal with

lupine seeds in lamb diet

↓

Growth performance

Meat quality

Material and methods

Experimental design

16 lambs

56 days of trial

CON
conventional maize-based diet

LUP
35% lupine replaced soybean meal and partially maize of the CON diet

Material and methods

Animal diets

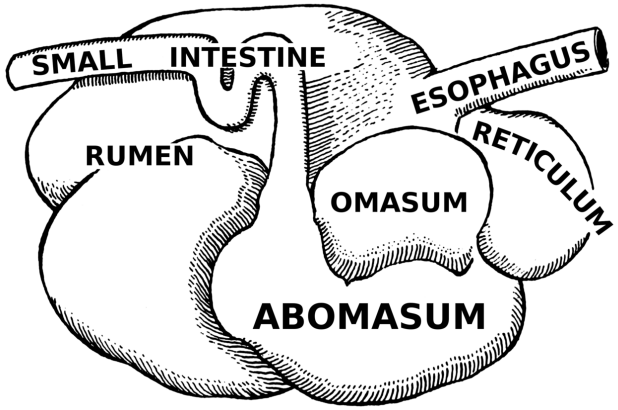
	Lupine	Diet	
		CON	LUP
Chemical composition, g/kg DM			
Dry Matter Intake (DM), g/kg as fed	919	907	911
Crude Protein	341	197	199
NDF	240	218	244
ADF	229	154	179
ADL	288	177	226
Ash	31.3	79.8	96.3
Extract Ether	71.5	19.5	42.1
Fatty acids, g/100 g total FA			
C16:0	9.76	21.3	12.7
C18:0	2.65	7.09	3.35
C18:1 *c*9	50.9	23.0	38.9
C18:2 *c*9*c*12	24.6	41.2	33.2
C18:3 *c*9*c*12*c*15	9.19	5.83	8.94
Vitamins, ug/g DM			
α-Tocopherol	<0.001	8.67	6.88
γ-Tocopherol	161	16.6	67.6

Sweet cultivar «Tennis»

Material and methods

Analyses

Growth performance



VFA

Ammonia

Fatty acid profile

Colour (fresh and storage)

Results

Growth performance

	CON	LUP	*P*-value
Growth performance			
DM intake (kg/day)	936	333	<0.001
Initial BW (kg)	13.2	12.4	0.491
Final BW (kg)	27.1	14.5	<0.001
Weight gain (kg)	13.9	2.11	<0.001
ADG (kg/day)	249	37.6	<0.001
Carcass traits			
Hot carcass weight (kg)	12.1	6.08	<0.001
Cold carcass weight (kg)	11.9	6.05	<0.001
Cold carcass yield (%)	43.6	41.3	0.111

1/3 compared to CON

1/2 compared to CON

Results

Rumen fermentation

	CON	LUP	*P*-value
pH	6.12	6.58	0.006
Ammonia (mol/L)	129	93.7	0.159
Total VFA (mmol/L)	290	225	0.064
Acetate (mol/mol)	74.4	81.8	0.001
Propionate (mol/mol)	20.9	12.3	<0.001
Butyrate (mol/mol)	3.35	4.86	0.015
Total *iso* (mol/mol)	0.522	0.730	0.134
Others (mol/mol)	1.37	1.02	0.138
Acetate/propionate ratio	3.65	7.06	<0.001

-22%

+10% acetate
-41% propionate

Results

Meat quality

	CON	LUP	*P*-value
IMF (g/100g meat)	1.59	1.34	0.241
18:0, stearic acid (%)	14.4	20.5	0.002
18:1 *t10* (%)	0.638	0.285	0.010
18:1 *t11*, vaccenic acid (%)	0.542	1.09	0.031
18:1 *c9*, oleic acid (%)	38.6	29.4	0.054
18:2 *c9t11*, rumenic acid (%)	0.298	0.504	0.010
18:2 n-6, linoleic acid (%)	8.38	9.05	0.592
18:3 n-3, α-linolenic acid (%)	0.129	0.302	0.008
SFA	42.6	48.6	0.230
MUFA	46.1	36.2	0.029
PUFA	11.3	15.2	0.078
n-6/n-3	7.86	4.21	<0.001
PUFA/SFA	0.268	0.338	0.247

+42%

+2-folds

+69%

+2-folds

<MUFA
>PUFA tendence

Results

Meat quality

	Dietary treatment		Time of storage			*P*-value		
	CON	LUP	0	4	7	Diet	Time	D×T
*L**	45.5	44.1	44.3	46.0	44.2	0.255	0.010	0.046
*a**	13.3	15.0	14.3	14.8	13.4	0.108	0.010	0.345
*b**	11.7	11.9	9.82	13.4	12.1	0.761	<0.001	0.216
*C**	17.8	19.2	17.3	20.0	18.1	0.253	0.001	0.292
Hue angle	40.8	38.4	34.3	42.2	42.3	0.010	<0.001	0.004

Little magnitude variations

Typical browning pattern

Conclusion

Total replacement of soybean meal with **lupine seed**

Deleterious effects on growth performance

Improve meat FA profile with health promoting FAs

New varieties with **low alkaloid content**

Thank you for the attention!

Martino Musati

martino.musati@phd.unict.it

Diet composition

mg/kg DM	**CON**	**LUP**
Maize	430	300
Hay	300	300
Soybean meal	220	-
Molasses	30	30
Vitamin-mineral integrator	20	20
Lupine seed	-	350