Assessment of the use of grape stem from wineries as a second-generation feedstuff to produce a new feed ingredient for ruminants (dairy sheep and cattle)

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NEWFEED: Turn food industry by-products into secondary feedstuffs via circular-economy schemes

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FEED FROM FOOD INDUSTRY BY-PRODUCTS

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CASE STUDY 1

Grape stem-based ingredients for dairy sheep and cattle

BAI GORRI

AZTI MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Riera Nadeu

NEIKER MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

UAGA

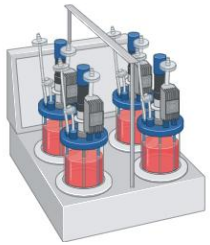
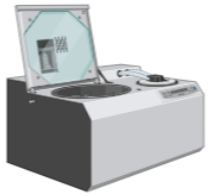
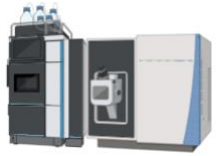
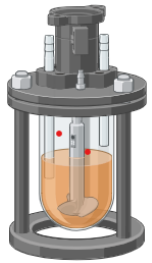
cesfac

CASE STUDY 1

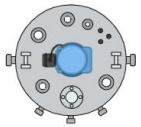
Grape stem-based ingredients for dairy sheep and cattle

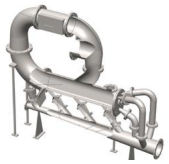
BAIGORRI provided grape stems


AZTI optimized and scaled up the processing

RIERA scaled up the entire process





NEIKER determined the feeding strategy based on the analysis of the obtained ingredients

Representative **of agriculture and feed sector**


Current situation

- EU is the world-leading producer of wine (75 % in Italy, Spain and France)
- Annual production: 167 million hectoliters (1,5 kg of grape -1 L wine) > 750.000 Tn GS

1 Kg → **0.03-0.07 Kg**

- Fibres
- Polyphenols
- Sugars

10,000 tons

Parameters	Unit	Value
Moisture	%	7.43
Ashes	%	6.28
Energy	kJ/100 g	1480
Protein	%	4.07
Total Carbohydrates	%	81.58
Neutral detergent fibre	%	40.81
Acid detergent fibre	%	40.81
Lignin acid detergent	%	19.72
Starch	%	4.90
Total sugars	%	19.74

1st

Grape stem from wineries as a second-generation feedstuff to produce a new feed ingredient for ruminants (dairy sheep and cattle). AZTI / Spain.

Grape stems are the only by-product of winemaking that is managed as a waste

Objective

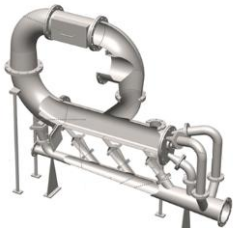
Optimize *an innovative* ***valorisation*** *and feeding strategies to turn* ***grape stems into high value secondary feedstuff*** *for animal feed and to test and validate the proposed value chain as secondary feedstuffs for animal feed (**TRL 6-7**). Including* ***a multi-actor approach*** *strategy - from the by-product generation, collection, processing-stabilizing, feed formulation, animal husbandry, consumer acceptability, sustainability, and regulatory aspects.*

Washing

Sugar rich liquor

Hydrolysis

Centrifugation



Flash dryer

Grape stemp ingredient

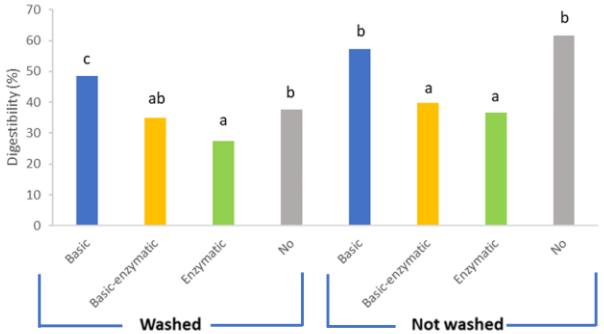
Nutritional characteristics
In vitro digestibility value
Ruminal fermentation kinetics

Feed formulation

Feeding test

Optimization of hydrolysis

- **Optimization of the hydrolysis** process in laboratory scale to **improve the nutritional** and **in vitro digestibility value**



Wash	Hydrolysis	Conditions
Yes	1. NaOH	1% NaOH, ratio 1:1.25 w/w 90 ^{o}C 3 h 250 rpm
No	2. Cellulolytic Enzymes	Enzymes 2 % 55 ^{o}C 20h
	3. NaOH + Cellulolytic enzymes	Consecutive processes

sustainability

MDPI

Article

Evaluation of Valorisation Strategies to Improve Grape Stems' Nutritional Value as an Ingredient for Ruminants' Diets

David San Martin [1,*], Jone Ibarruri [1], Nagore Luengo [1], Jorge Ferrer [1], Aser García-Rodríguez [2], Idoia Goiri [2], Raquel Atxaerandio [2], Jaime Zufía [1], Estíbaliz Sáez de Cámara [3] and Bruno Iñarra [1]

d lead to a decrease in polyphenols and sugars

cal drying

o all treatments only when samples are washed due to

Optimization of hydrolysis

- **Optimization of the hydrolysis** process in laboratory scale to **improve the nutritional** and **in vitro digestibility value**

Wash	Hydrolysis	Conditions
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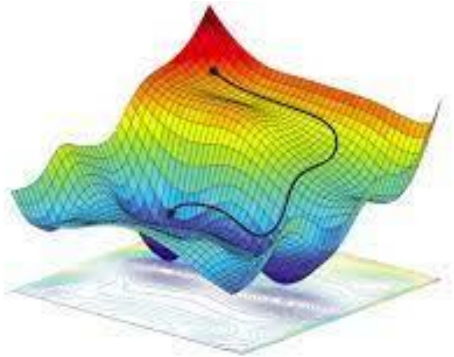
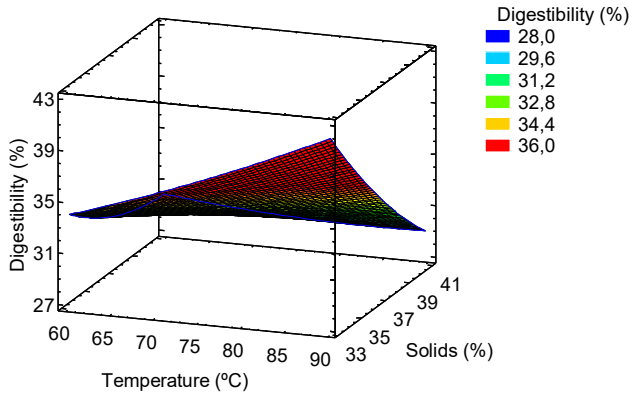


Factor	Selected conditions
Temperature (°C)	90
Time (h)	2.3
Solids (%)	33.0

	Non-hydrolysed sample	Hydrolysed sample
Protein (%)	5.5	5.9
Ash (%)	9.1	12.6
NDF (%)	45.0	44.0
ADF (%)	40.6	43.7
ADL (%)	24.2	31.9
TRS (%)	234	211
TPC (mg/g)	38.0	32.9
IVOMD (%)	30.31	43.0
Total VFA (mmol)	5.32	5.39

Lab scale

Optimization



Pilot scale

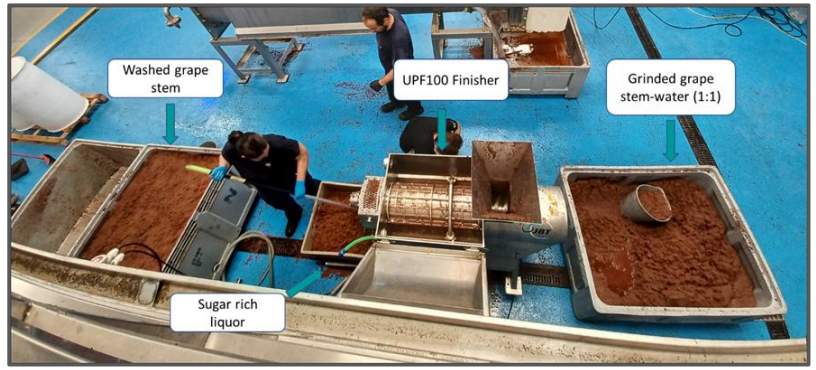
Scaling up the process 1. New ingredient production

Sourcing and transport

Grinding (69 % of moisture- 18° brix)

Washing

Grape stem → 0.65 (80% moisture)
Liquor → 0.35 (6-7 ° brix)



Hydrolysis + Mechanical dewatering

Flash drying

Dried grape stems (10 % of moisture)

Scaling up the process 2. Animal efficiency trials with dairy sheep and dairy cow

Animal efficiency trials with dairy sheep

- **36 multiparous dairy ewes**

To assess the effect in dairy sheep of incorporating dried grape stems hydrolysed or not on:

1. **Milk yields**
2. **Milk quality**
3. **Curds sensory properties**
4. **Enteric methane emissions**

28 days for data collection

- Milk production measured daily
- Sampled weekly to monitor the milk composition (Protein, Fat, Lactose and FA profile)
- Methane concentration 2 days/week

Animal efficiency trials with dairy sheep

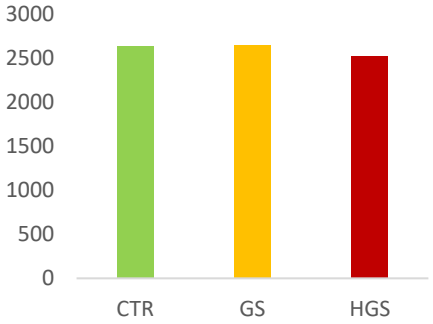
Concentrate formulation: isoenergetic and isoproteic

	CTR	GS/HGS
Ingredients (%)		
Barley	5	19
Oats	53	24
Maize	10	15
ddgs	0	5
Rapeseed meal	21	16
Rapeseed oil	5	5
Molasses	3	3
Grape stems		10
VIT-MIN	3	3
Nutritive value		
UFL	1,01	0,99
CP (%)	15,8	16,1
Fat (%)	8,9	9,3
Starch (%)	32,2	32,6

Animal efficiency trials with dairy sheep

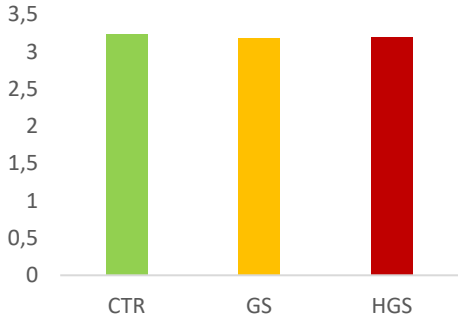
Results

Milk yield (mL/d)



P=0.482

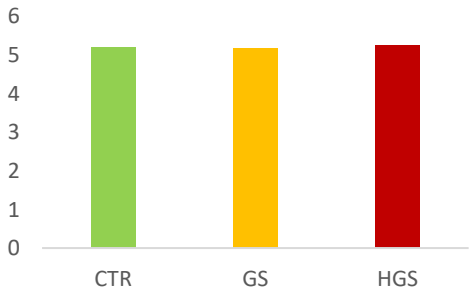
Dry matter intake, kg/d



P=0.918

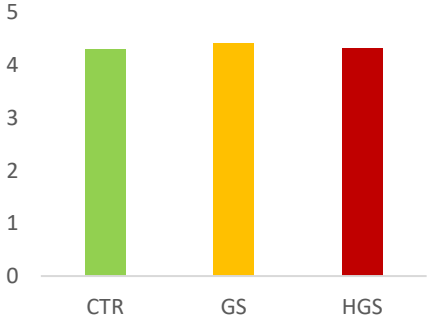
Milk composition, %

Fat



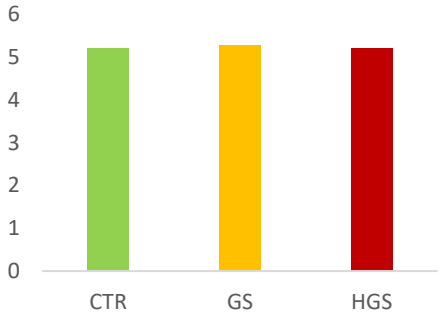
P=0.864

Protein



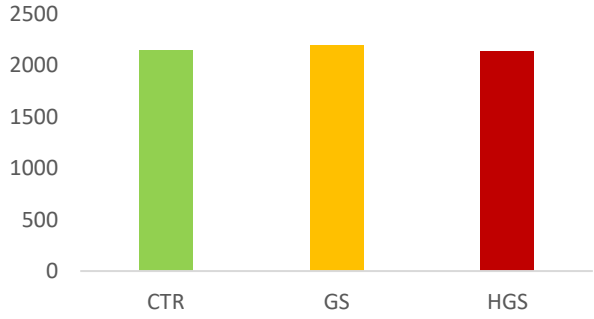
P=0.366

Lactose



P=0.129

Protein-Fat Corrected Milk yield (mL/d)

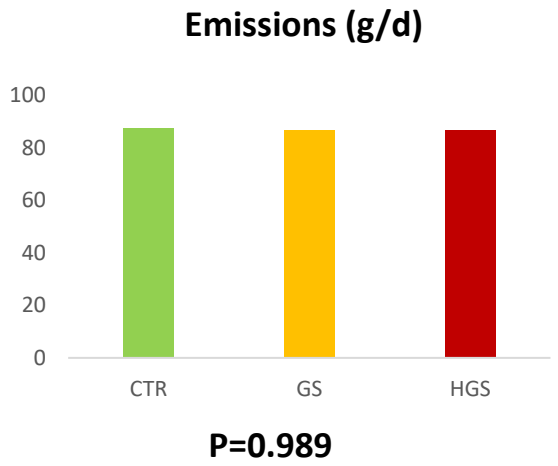


P=0.818

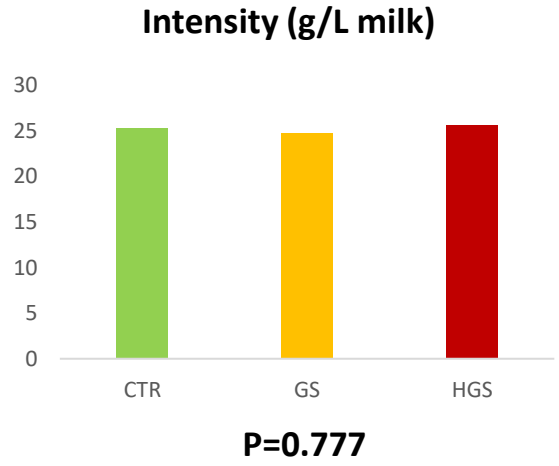
Animal efficiency trials with dairy sheep

Results

Methane emissions

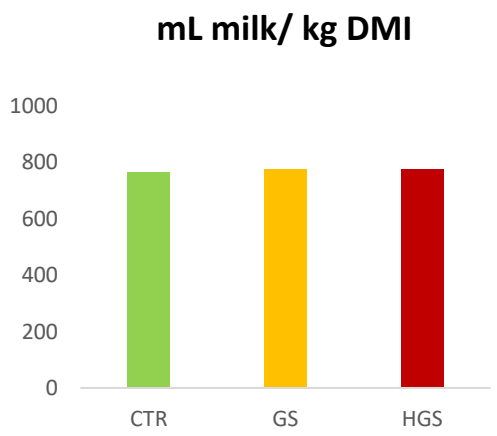


P=0.989

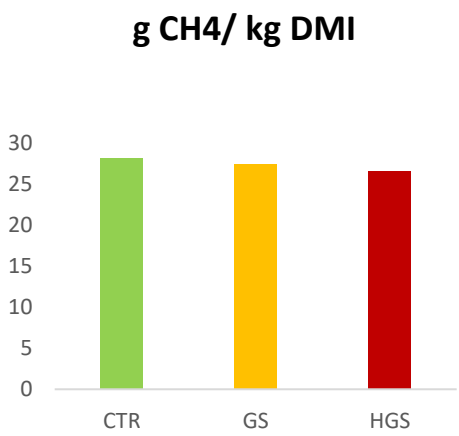


P=0.777

Production efficiency



P=0.987

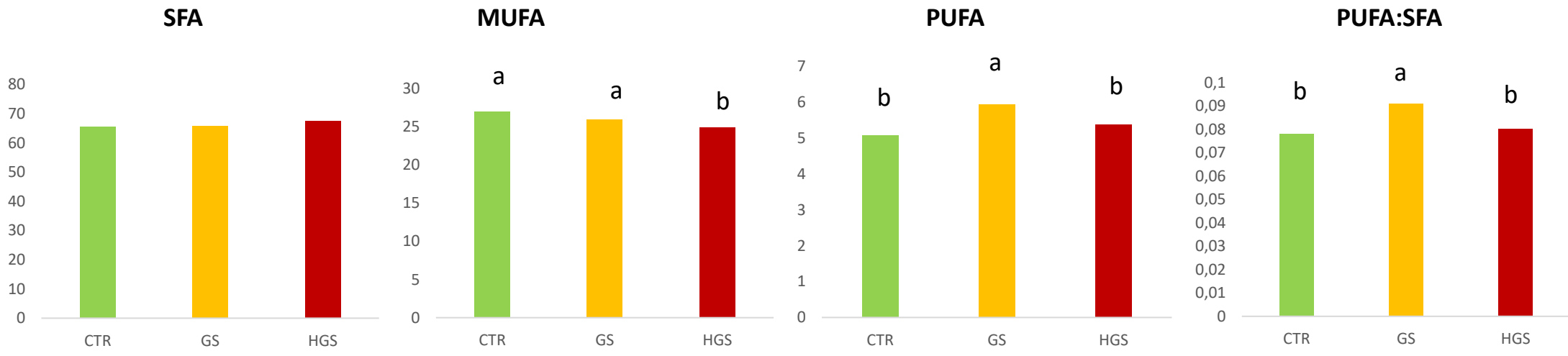


P=0.620

Animal efficiency trials with dairy sheep

Results

Milk fatty acid profile, %



P=0.160

P=0.075

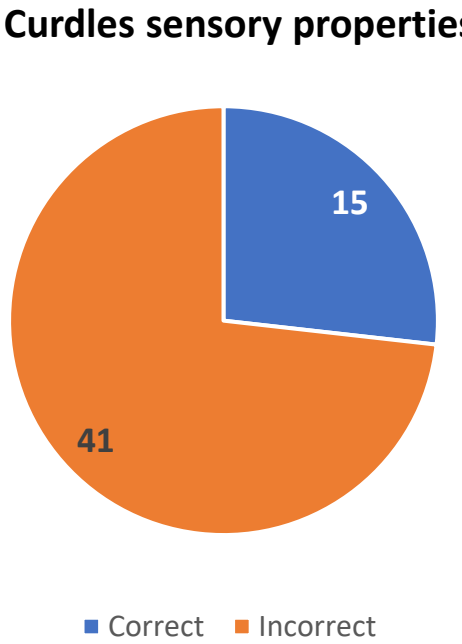
P=0.003, 17.1%

P=0.011, 16.6%

- GS Improved milk fatty acid composition towards a healthier one

Animal efficiency trials with dairy sheep

Results



56 consumers

>23 correct answers to conclude that consumers can distinguish them

- Consumers cannot distinguish curdles produced with milk obtained from ewes consuming 10% GS

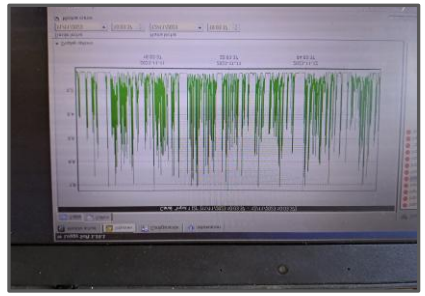
Animal efficiency trials with dairy cows

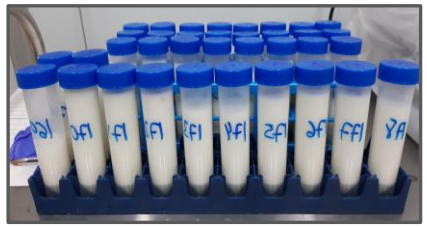
- **16 cows** have paired according to breed, parity and milk production

To assess the effect in dairy cows of incorporating dried grape stems:

1. **Milk yields**
2. **Milk quality**
3. **Curds sensory properties**
4. **Enteric methane emissions**

- Methane emissions measured daily
- Milk production measured daily
- Milk sampled to monitor the milk composition: at the beginning and end of the trial
- Milk fatty acid profile: once at the end of the trial
- 25 litres of milk per treatment was sampled for the milk sensory analysis





Animal efficiency trials with dairy cows

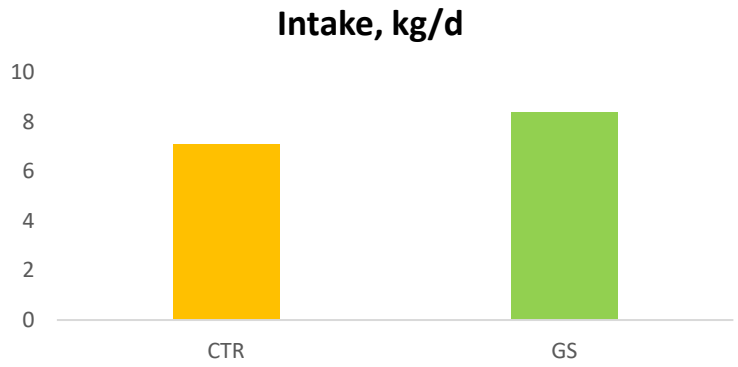
Concentrate formulation: isoenergetic and isoproteic

	CTR	GS
Ingredients (%)		
Maize	34.2	37.0
Soybean meal	25.1	28.7
Palm kernel meal	15.0	8.0
Wheat middlings	14.4	4.0
Rapeseed meal	2.0	3.0
Sunflower meal	1.1	1.0
Grape stems		10.0
Fat salts	2.9	2.9
Molasses	2.0	2.0
Calcium carbonate	1.7	1.7
Sodim bicarbonate	1.1	1.1
Sodium chloride	0.2	0.2
Minerals	0.3	0.3
Nutritive value		
UFL	1.02	1.01
CP (%)	19.0	19.0
Fat (%)	6.0	6.0
Starch (%)	25.0	25.0

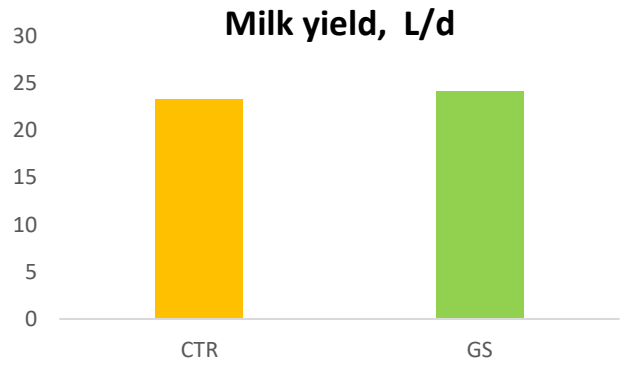
Animal efficiency trials with dairy cows

Results

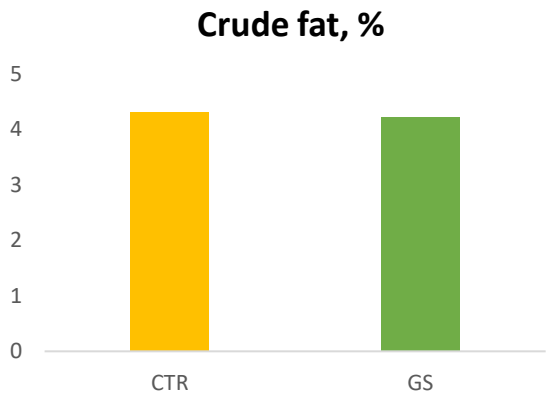
Intake and productive performance



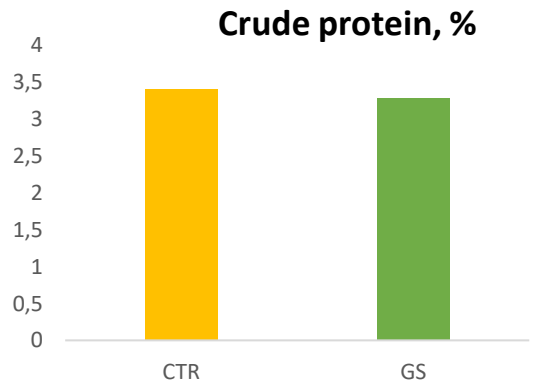
P=0.016



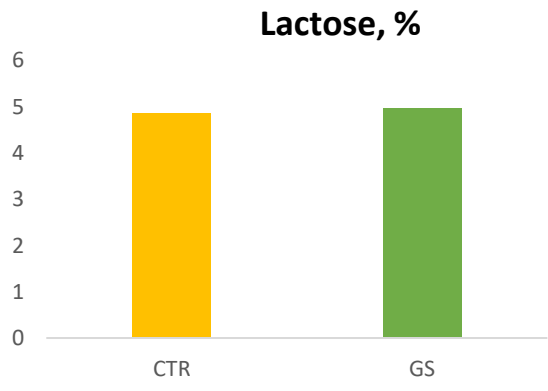
P=0.499



P=0.697



P=0.076

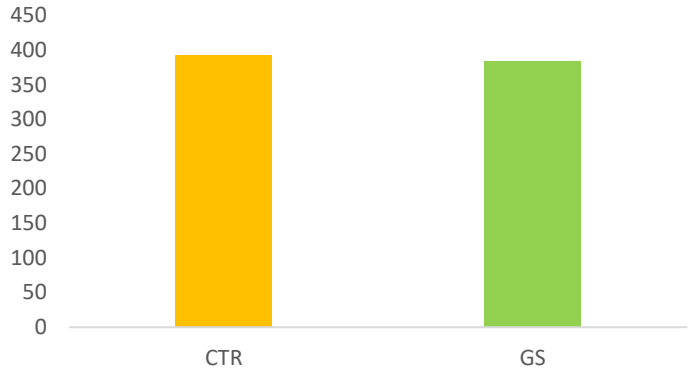


P=0.164

Animal efficiency trials with dairy cows

Results

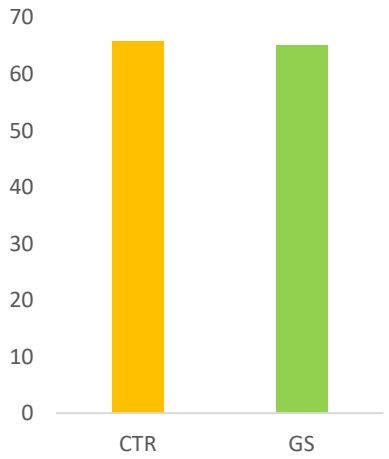
Methane emissions g/d



P=0.748

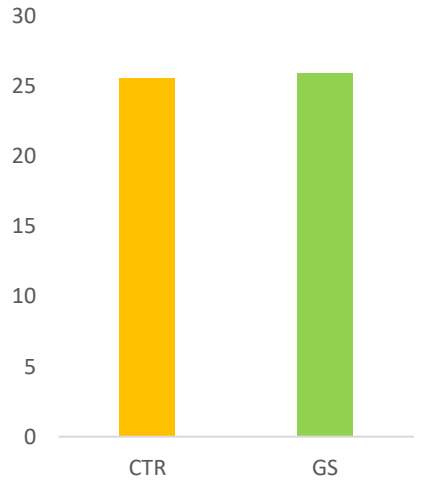
Milk fatty acid profile

SFA, %



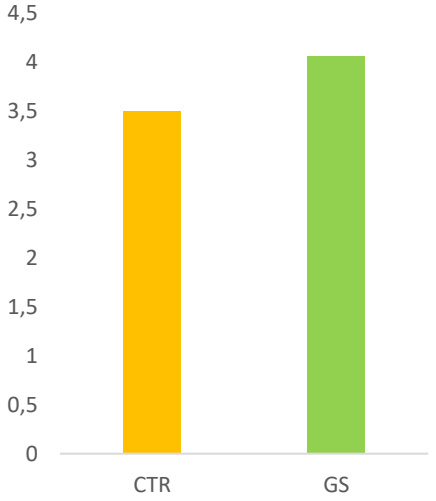
P=0.447

MUFA, %



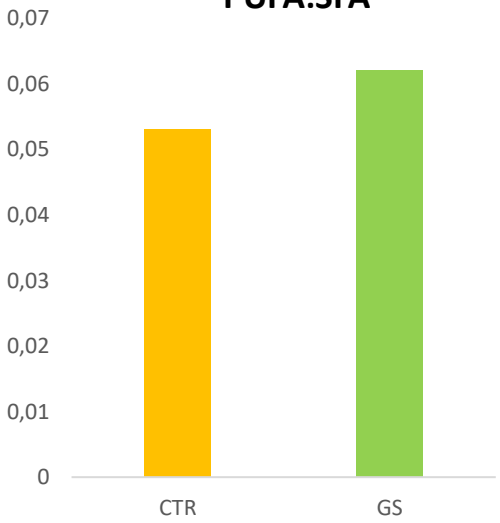
P=0.687

PUFA, %



P=0.022; 16.3%

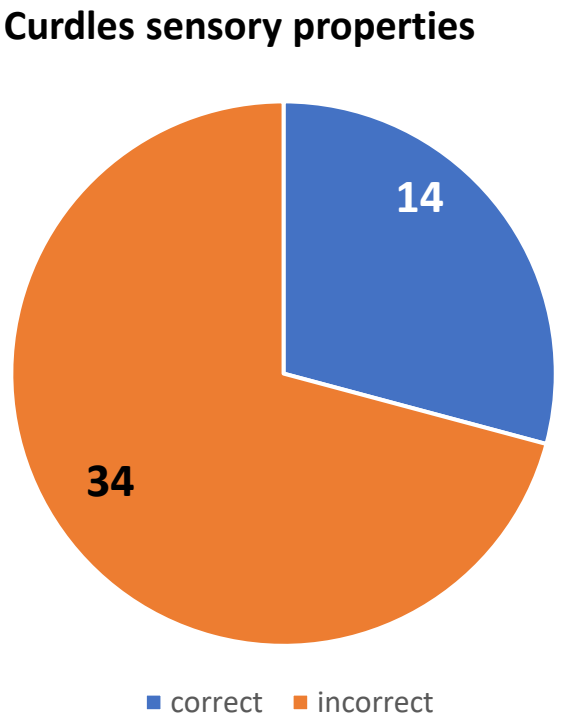
PUFA:SFA



P=0.031; 16.9%

Animal efficiency trials with dairy cows

Results



48 consumers

>25 correct answers to conclude that consumers can distinguish them

- Consumers cannot distinguish milk obtained from cows consuming 10% GS

CONCLUSIONS

- The **washing** process **reduces the sugar content** improving drying efficiency and solve the fermentation processes associated with the high sugar content in the raw material.
- Although **alkali hydrolysis** also **reduced sugar content** and **increased fibre components**, **digestibility was improved** compared to control.

- **Hydrolysing** grape stems does **not** provide **any productive advantage in terms of animal efficiency** parameters that can justify the process.
- **Grape stems** in the concentrate (**10 % inclusion**) **increases milk PUFA** without impairing milk production or composition, methane emissions or production efficiency.
- Consumers cannot distinguish curdles produced with milk obtained from animals consuming 10% GS. **Consumer acceptance.**
- **Unprocessed, simply washed and dried grape stem** yielded **better results** in feeding trials compared to the hydrolysed one, **making them a cost-effective alternative.**

Thank you for your attention!

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Project Partnership

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https://newfeed-prima.eu/

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