

Dietary supplementation of orange peel ingredient in lactating ewes: Effect on yoghurt physicochemical characteristics

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INTRODUCTION

- Modern sheep farming faces significant challenges, such as meeting the growing demand for animal products, adhering to evolving welfare standards, and addressing the impacts of climate change.
- Farmers, who are particularly vulnerable to market speculation due to their reliance on expensive imported feed, are in urgent need of sustainable alternatives.
- In the Mediterranean region, a promising solution exists in the form of food by-products as they offer nutritional benefits and are readily available.
- Notably, orange juice production yields substantial by-products, up to 60% of the total fruit weight.
- These by-products, characterized by high digestibility and energy content, present an attractive secondary feed option.
- Furthermore, sheep milk yoghurt is highly valued in Greece for its rich, creamy texture and unique flavour profile.
- Yoghurt market success heavily relies on factors such as colour, viscosity, syneresis, and texture, underlining the importance of these sensory aspects for consumers.

SCOPE

Evaluation of the impact of dietary supplementation with dried orange peel ingredients on the physicochemical characteristics of sheep milk yoghurt.

MATERIALS AND METHODS

- **Animals and diets**
 - Chios breed dairy ewes distributed into three groups (12 animals) according to previous milk yield and lactation number
 - Group 1: Control
 - Group 2: Unprocessed Orange Peels (UOP) - 11% of DM intake
 - Group 3: Processed Orange Peels (enzymatically hydrolysed) (POP) - 11% of DM intake
 - Isonitrogenous and isoenergetic diets formulated by substituting conventional feed ingredients to meet nutrient requirements.
 - Animals fed over 84 days, from post-weaning to the 16th week of lactation.
- **Yoghurt preparation**
 - Traditionally produced yoghurt from bulk – tank milk (3 batches on separate days) refrigerated for 21 days
- **Physicochemical characteristics (storage day 14)**
 - Colour (CIELAB system L*, a*, b*, Chroma (colour saturation index), hue and Whiteness index assessed according to the equation

$$WI = 100 - \sqrt{((100 - L^*)^2 + a^{*2} + b^{*2})}$$
 - Syneresis by gravity and centrifugation
 - Consistency (back extrusion test with a cylindrical plate probe to determine firmness, adhesiveness, and stickiness)
 - Rheological properties (viscosity)
- **Statistical analysis**
 - One-way analysis of variance (ANOVA) to assess statistically significant differences in the physicochemical characteristics of the three types of yoghurt.

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RESULTS AND DISCUSSION

- No significant differences (P>0.05) in lightness (L*), hue angle, and whiteness index (Table 1).
- Significant differences (P<0.01 – P<0.05) in redness (a*), yellowness (b*), and chroma (colour saturation index) between treatments.
- Differences in redness, yellowness, and chroma were mainly between the Control and the UOP group.
- No significant differences (P>0.05) in yoghurt syneresis between treatments, assessed by both methods.
- Yoghurt texture was markedly influenced, with those produced from the milk of ewes on the UOP treatment exhibiting greater firmness, cohesiveness, and stickiness.
- The lack of significant effects on viscosity implies that the overall texture profile remains consistent across treatments.
- Differences in yoghurt proximate composition (moisture, fat, protein contents) were closely related to variations in the examined traits.

Table 1. Yoghurt physicochemical characteristics.

Variable	Treatment			Significance
	Control	UOP	POP	
<i>Colour</i>				
Lightness (L*)	88.48	87.30	87.41	NS
Redness (a*)	-0.92	-1.59 ^a	-0.81 ^b	P<0.05
Yellowness (b*)	-10.81 ^a	-8.86 ^b	-10.49	P<0.01
Chroma	10.87 ^b	9.18 ^a	10.53	P<0.01
Hue	242.20	256.46	254.20	NS
Whiteness	84.10	84.10	83.51	NS
<i>Syneresis</i>				
Gravity (%)	0.42	0.25	0.01	NS
Centrifugation (%)	13.72	12.26	13.49	NS
<i>Consistency</i>				
Firmness (g)	310.25 ^a	517.25 ^b	330.00 ^a	P<0.001
Adhesiveness (g f mm)	-1935.25 ^a	-3224.00 ^b	-2374.00	P<0.05
Stickiness (g)	-92.00 ^a	-158.75 ^b	-111.75	P<0.05
<i>Rheological properties</i>				
Viscosity (mm ² /s)	14094.50	18960.00	15472.25	NS

CONCLUSIONS

- Utilizing food by-products such as orange peels as dietary supplements for ewes presents a sustainable secondary feed alternative.
- Supplementation with both unprocessed (UOP) and processed (POP) orange peels improved yoghurt texture without negatively impacting other quality traits like whiteness and syneresis.

