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Effect of chicory (*Cichorium intybus*) sward on fatty acids profile in different lamb's tissues

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Introduction

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- Meat is essential in human nutrition;
- However, it has been linked to health issues;
- Improving meat's fatty acid profile can improve health benefit.

Pobiner, 2013; Baltic & Boskovic, 2015; Kamboh et al., 2019



Introduction

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- Chicory (*Cichorium intybus*) is a nutrient-rich forage with bioactive compounds.



- Other plant additives influenced rumen microbes, lipid metabolism, and meat fatty acid (FA) composition.

Nwafor et al., 2017; Khoobani et al., 2020; Aloo et al., 2023; Rahn et al., 2023

Introduction

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- Despite its potential, limited research has investigated chicory's effects on the FA profiles of specific lamb tissues, such as the rumen, liver, meat, and fat.



Hypothesis

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- Incorporating chicory into lamb diets may reduce rumen BH activity, thereby increasing the concentrations of biologically beneficial FA in lamb tissues

Objective

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- To evaluate the impact of chicory supplementation on the FA profiles of rumen fluid, liver, muscle, and subcutaneous fat.



Materials & Methods

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16 Tsigai breed lambs (1:1 male and female) of 3-4 months old (13.6 ± 0.52 kg body weight)

2 groups – control (con) and experimental (exp) (n= 8; 1:1 male and female)

Con – natural meadow sward

Exp – chicory-enhanced sward



Materials & Methods

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145 days of trial

The lambs were housed in shared shelters on a commercial sheep farm



Materials & Methods

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Sample collection



- Feed samples
- Rumen fluid
- Blood serum
- Liver
- Subcutaneous fat
- Muscle

Materials & Methods

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Chemical analysis

- Nutrient composition
- Fatty acid

Data analysis

- RStudio Version 2022
- One-way ANOVA
- Student's t-test

Results

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Table 1 – Nutrient composition of diets (g/kg DM unless specifically stated)

Constituents	Hay	Concent rate	Chicory 1*	Pasture 1*	Chicory 2**	Pasture 2**
Dry matter (g/kg fresh basis)	893	898	895	882	879	890
Ash	76.1	109	173	138	165	105
Crude protein	99.8	206	157	120	162	148
Crude fibre	243	71.8	130	179	144	176
Acid detergent fibre	408	112	291	296	410	462
Neutral detergent fibre	768	323	356	493	488	596

* - Harvested in May 2023; ** - Harvested in September 2023

Results

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Table 2 – Fatty acid profile of experimental diets (g/100 g FA)

Fatty acids	Hay	Concentrate	Control*	Chicory*
C18:0	11.3	3.85	4.10	7.68
C18:1cis 9	14.0	22.8	6.05	6.22
C18:2c9c12	23.3	41.2	19.9	20.2
C18:3c9c12c15 (3n3)	12.3	3.30	39.7	30.6
Σ SFA	50.4	32.7	34.4	36.7
Σ UFA	49.6	67.4	65.7	63.3
Σ n-6	23.3	41.2	19.9	20.2
Σ n-3	12.3	3.30	39.7	33.1

* - harvested in September, 2023; SFA – saturated fatty acids; UFA – unsaturated fatty acids; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids Fatty acid in ruminal fluid

Results

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Table 3 - The effect of chicory sward on ruminal fatty acid proportions (g/100 g FA) in lambs

Fatty acids	Control	Experimental	SEM	p value
C18:0	35.1	33.8	0.766	0.42
C18:1 trans-11	4.28	4.15	0.185	0.74
C18:1 cis-9	6.92	11.59	0.844	<0.01
Σ Other FA	8.71	6.61	0.275	<0.01
Σ SFA	71.9	67.7	0.822	0.01
Σ UFA	28.1	32.3	0.822	0.01
Σ n-6	5.00	5.94	0.233	<0.05
Σ n-3	3.11	2.51	0.102	<0.01
LA BH, %	90.7	88.3	0.582	0.03
LNA BH, %	88.8	85.3	0.832	0.03

LA - linoleic acid; LNA - linolenic acid; BH- biohydrogenation, FA – Fatty acid; SEM - standard error of the mean; Σ SFA – total saturated fatty acids; Σ UFA – total unsaturated fatty acids; Σ MUFA – total monounsaturated fatty acids; Σ PUFA – total polyunsaturated fatty acids; Others - C10:0, C13:0, C15:0, C17:0, C18:1 trans-6-8, C18:1 trans-9, C20:1-trans, C18:3 n6, C21:0, C20:2, C20:3 n6, C20:3 n3, C22:2, C20:5 n3, C22:5 n3, C22:6 n3

Results

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Table 4 - The effect of chicory sward on serum fatty acid proportions (g/100 g FA) in lambs

Fatty acids	Control	Experimental	SEM	p value
C18:0	25.1	21.2	1.061	0.07
C18:1 trans-11	1.87	1.84	0.115	0.73
C18:1 cis-9	18.5	20.5	0.511	0.06
Σ Other FA	7.57	9.41	0.373	0.03
Σ SFA	55.3	50.7	1.205	0.06
Σ UFA	44.7	49.3	1.205	0.06
Σ n-6	15.3	16.2	0.795	0.52
Σ n-3	3.83	5.43	0.385	0.04

FA – Fatty acid; SEM - standard error of the mean; Σ SFA – total saturated fatty acids; Σ UFA – total unsaturated fatty acids; Σ MUFA – total monounsaturated fatty acids; Σ PUFA – total polyunsaturated fatty acids; Others - C10:0, C18:1 trans-6-8, C18:1 trans-9, C18:3 n6, C21:0, C20:2, C20:3 n6, C22:1 n9, C20:3 n3, C20:4 n6, C22:2, C20:5 n3, C22:5 n3, C22:6 n3

Results

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Table 5 - The effect of chicory sward on fatty acid proportions (g/100 g FA) in liver of lambs

Fatty acids	Control	Experimental	SEM	p value
C18:0	27.9	24.9	0.403	<0.01
C18:1 trans-11	1.56	0.95	0.162	0.06
C18:1 cis-9	14.5	17.6	0.552	<0.01
Σ Other FA	22.5	21.0	0.462	0.07
Σ SFA	47.7	45.4	0.320	<0.01
Σ UFA	52.3	54.6	0.320	<0.01
Σ n-6	17.6	16.6	0.179	0.01
Σ n-3	13.6	14.2	0.343	0.38

FA – Fatty acid; SEM - standard error of the mean; Σ SFA – total saturated fatty acids; Σ UFA – total unsaturated fatty acids; Σ MUFA – total monounsaturated fatty acids; Σ PUFA – total polyunsaturated fatty acids; Others - C15:0, C18:1 trans-6-8, C18:1 trans-9, C20:3 n6, C20:3 n3, C20:4 n6, C20:5 n3, C22:5 n3, C22:6 n3

Results

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Table 6 - The effect of chicory sward on the fatty acid proportions (g/100 g FA) of the subcutaneous fat of lambs

Fatty acids	Control	Experimental	SEM	p value
C18:0	41.1	41.1	0.396	0.93
C18:1 trans-11	3.50	4.07	0.129	0.03
C18:1 cis-9	17.8	19.6	0.327	0.01
Σ Other FA	5.66	5.06	0.000	<0.01
Σ SFA	64.8	64.5	0.295	0.60
Σ UFA	35.2	35.5	0.295	0.60
Σ n-6	3.75	3.27	0.070	<0.01
Σ n-3	1.67	1.13	0.062	<0.01

FA – Fatty acid; SEM - standard error of the mean; Σ SFA – total saturated fatty acids; Σ UFA – total unsaturated fatty acids; Σ MUFA – total monounsaturated fatty acids; Σ PUFA – total polyunsaturated fatty acids; Others - C15:0, C18:1 trans-6-8, C18:1 trans-9, C20:3 n6, C20:3 n3, C20:4 n6, C20:5 n3, C22:5 n3, C22:6 n3

Results

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Table 7 - The effect of chicory sward on fatty acid proportions (g/100 g FA) of the Longissimus dorsi muscle of lambs

Fatty acid	Control	Experimental	SEM	p value
C18:0	21.3	21.1	0.363	0.82
C18:1 trans-11	1.58	1.00	0.086	<0.01
C18:1 cis-9	33.2	31.9	0.578	0.30
Σ Other FA	6.41	6.16	0.268	0.68
Σ SFA	46.08	47.15	0.434	0.23
Σ UFA	53.92	52.85	0.434	0.23
Σ n-6	9.63	9.97	0.487	0.74
Σ n-3	3.10	3.69	0.190	0.13
n-6/n-3	3.16	2.70	0.053	<0.01
Elongase index	1.04	0.98	0.022	0.20
Thrombogenic index	1.26	1.27	0.035	0.92
Atherogenicity index	0.49	0.53	0.012	0.10

FA – Fatty acid; SEM - standard error of the mean; Σ SFA – total saturated fatty acids; Σ UFA – total unsaturated fatty acids; Σ MUFA – total monounsaturated fatty acids; Σ PUFA – total polyunsaturated fatty acids; Others - C15:0, C18:1 trans-6-8, C18:1 trans-9, C20:3 n6, C20:3 n3, C20:4 n6, C20:5 n3, C22:5 n3, C22:6 n3

Conclusion

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- Chicory supplementation modulated ruminal microbial activity.
- It can improve FA profile in lambs' tissues by reducing SFA
- Further research is needed to assess the effects on meat sensory attributes and consumer acceptance



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Thank you for your attentive listening!