

1 **Effect of low and high concentrate supplementation on health and welfare indicators in**
2 **different breeds in small-scale mountain dairy farms**

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6 SUPPLEMENTARY FILE

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8 **Table S1.** Animal based measures, the assessment method, classification and evaluation on farm level

Measure	Assessment method	Classification	Farm level
BCS	BCS is evaluated with the scale of Edmonson et al. (1989), with score 1 and 2 indicating a poor body condition, 3 normal, 4-5 fat	Score 1-5	Percent of cows with a BCS \leq 2
Cleanliness of animals ¹	No: Less than 25% of the area in question covered with dirt Yes: 25% of the area in question or more covered with dirt	Yes No	Percent of cows considered with Yes in the area of question
Hairless patches ²	Area of a minimum diameter of 2 cm with hair loss but no damaged skin	Number of hairless patches in the recorded body area	Percent of cows with hairless patches in the respective body area
Lesions ²	Damaged skin either in form of a scab or a wound with a diameter of < 2 cm	Number of lesions in the area of question	Percent of cows with lesions in one area of question
Open shoulder	Animals showing the point of the shoulder oriented outward and not in line with the fore leg (Mattiello et al., 2011)	Yes No	Percent of cows with an open shoulder
Lameness	Standing animals were considered as lame if at least two indicators ³ of Leach et al. (2009) applied Moving animals were considered as lame when at least one indicators ⁴ of Welfare Quality® (2009) applied	Lame Not lame	Percent of animals considered as lame
Ocular discharge	Animals with clearly visible flow/discharge from the eye	Yes No	Percent of animals with ocular discharge
Vulvar discharge	Animals with a purulent effluent from the vulva	Yes No	Percent of animals with vulva discharge
Nasal discharge	Animals with clearly visible flow/discharge from the nostrils	Yes No	Percent of animals with nasal discharge
Hampered respiration	Animals with deep and overtly difficult or labored breathing	Yes No	Percent of animals with hampered respiration

Diarrhea	Animals with loose watery faeces or loose watery manure below the tail head on both sides of the tail	Yes No	Percent of animals with diarrhea
Incorrect lying down behavior	Animals having either a prolonged time to lie down (> 7 seconds) or a collision with housing equipment	Yes No	Percent of animals with a hampered lying down behavior

9 ¹recorded at hind leg, hindquarter, flank/side, neck/shoulder, front leg, udder

10 ² recorded at hind leg, hindquarter, flank/udder, neck/shoulder, front leg

11 ³ Regular, repeated shifting of weight from one foot to another; rotation of feet; standing on the edge of a step; resting a foot; uneven
 12 weight bearing between feet when moving

13 ⁴ Reluctance to bear weight on a foot; uneven temporal rhythm between hoof beats

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15 **Table S2.** Reproductive and health parameters, the assessment method, the classification and evaluation on farm level

Areas of concern	Assessment method	Classification	Farm level
Age at first calving	Derived from the breeding data	Age at first calving in month	Average age at first calving
Calving interval	Derived from milk test day records	Days between one and the next calf	Average calving interval
Insemination index	Derived from breeding data	Inseminations needed per successful pregnancy	Average insemination index
Lifetime production	Derived from milk test day records; only for culled cows	Produced kg ECM during all lactations	Average lifetime production
Cell count	Derived from milk test day records	Cell count/ml milk	Cows with a cell count \geq 400,000/ml (%)
Milk urea	Derived from milk test day records	mg/kg milk	Cows with a milk urea \geq 300 mg/l (%)
Fat protein ratio (FPR)	Derived from milk test day records	% fat in milk / % protein in milk	Cows with a FPR < 1 (%)
Numbers of lactation	Derived from milk test day records; only for culled cows	No. of lactations per cow	Average number of lactations
Dystocia	Questionnaire	Calvings per year and farm with veterinarian help/ total calvings per year and farm	Dystocia (%)

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17 **Table S3.** Resource based parameters, the assessment method, the classification and evaluation on farm level

Areas of concern	Assessment method	Classification	Farm level
Business organization	Questionnaire	Full time Part time	Full time Part time
Days on pasture	Questionnaire	Days dairy cows spend on pasture/year	Days on pasture
Concentrate/cow and day	Questionnaire	Kg concentrate/cow and day	Average kg concentrate/cow and day
Husbandry system	On farm assessment	Tie stall Loose housing	Tie stall Loose housing
Tie stall design	On farm assessment	Tethers Neck bracket	Tethers Neck bracket
Electric cow trainer	Presence of an electric cow trainer	Yes No	Yes No
Dirty water points	Water points are considered as dirty when there is crust of dirt and/or decayed food residues	Yes No	Dirty water points (%)
Length of lying area	Sized with a tape measure	cm	Average length of lying area
Width of lying area	Sized with a tape measure	cm	Average width of lying area
Window area	Measured with a tape measure	m ²	m ²
Air quality	Subjective assessment by observer	Good Medium Bad	Good Medium Bad
Energy content of hay	Bulk sample from at least 5 individual samples	MJ/ kg DM ¹	MJ/ kg DM
Milk out of roughage	Calculated with a formula by Weiß (2001), considering the used concentrate/cow and day	Formula by Weiß (2001)	Milk out of roughage (%)

18 ¹ Megajoule per kg dry matter

Supplementary Table S4 Prevalence of animal based measures in L-TG, L-BS, H-TG and H-BS

Animal based measures (% animals/farm)	Mean ±Std				P-value		
	L-TG	L-BS	H-TG	H-BS	Breed	Intensity level	Breed*Intensity level
N	14	15	15	20			
Lean Cows*	9.5 ^a ±7.1	28.3 ^b ±12	13.2 ^a ±7.2	15.1 ^{ab} ±8.3	< 0.001	< 0.001	n.s
Dirty flank and upper leg	34.5 ^{ab} ±30.2	49 ^a ±28.5	12.8 ^b ±12.3	19.6 ^b ±19.2	n.s	< 0.001	n.s
Dirty hind leg	26.8 ^a ±27.6	53.7 ^b ±36.4	20.2 ^a ±24.7	20.3 ^a ±28	0.04	< 0.001	0.04
Dirty udder	27.5 ^{ab} ±26.6	36.1 ^a ±26.6	11.7 ^b ±19.5	21.9 ^{ab} ±22.4	n.s	0.02	n.s
Hairless patches	2.5 ^{ab} ±4.2	10.8 ^a ±17.9	0.9 ^b ±2.4	4.2 ^{ab} ±6.5	0.03	n.s	n.s
Lesions	6.4 ^a ±6.5	5.0 ^a ±8.6	10.2 ^a ±12.8	16 ^a ±25.1	n.s	n.s	n.s
Open shoulder	19.1 ^a ±12.3	16.9 ^a ±9.8	23.5 ^a ±17.9	12.8 ^a ±13.7	n.s	n.s	n.s
Lameness	8 ^a ±2.3	5.1 ^a ±4.8	9.8 ^a ±7.6	15 ^a ±13.2	n.s	n.s	n.s
Ocular discharge	0 ^a ±0	1.8 ^a ±0.6	1 ^a ±0.5	0.3 ^a ±0.1	n.s	n.s	n.s
Vulvar discharge	1.4 ^a ±0.3	2.6 ^a ±0.5	2.6 ^a ±0.8	3.7 ^a ±1.2	n.s	n.s	n.s
Nasal discharge	2.9 ^a ±1.9	2.3 ^a 2.0	1.4 ^a ±1.0	1.2 ^a ±0.8	n.s	n.s	n.s
Hampered respiration	2.4 ^a ±0.6	2.1 ^a ±0.3	0.8 ^a ±0.6	0.9 ^a ±0.4	n.s	n.s	n.s
Diarrhea	1.4 ^a ±1.0	4.6 ^a ±1.8	2.8 ^a ±0.8	4.2 ^a ±0.7	n.s	n.s	n.s
Lying down behaviour	29.3 ^a ±20.1	21.1 ^a ±11.3	23.8 ^a ±17.3	23.0 ^a ±25.2	n.s	n.s	n.s

* Cows with a BCS ≤ 2.0 were considered as lean

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Supplementary Table S5 Health and reproductive data for L-TG (N=14), L-BS (N=15),
H-TG(N=15) and H-BS farms (N=20)

	Mean ±Std				P-value		
	L-TG	L-BS	H-TG	H-BS	Breed	Intensity level	Breed*Intensity level
Age at first calving (months)	33.5 ^a ±1.9	32.9 ^a ±2.9	33.3 ^a ±1.6	30.8 ^b ±1.8	< 0.01	0.04	n.s
Calving interval (days)	411.9 ^a ±30.6	489.7 ^b ±78.7	421.4 ^a ±37.1	436.1 ^a ±33.6	<0.01	n.s	0.02
Insemination index	1.7 ^a ±0.4	1.9 ^a ±0.8	1.8 ^a ±0.5	2 ^a ±0.7	0.02	n.s	n.s
Lifetime production (kg ECM)	16,560 ^a ±4330	19,546 ^a ±3969	20,171 ^a ±6465	20,099 ^a ±4713	n.s	n.s	n.s
Cell count > 400,000 (% animals)	6.7 ^{ab} ±11.3	12.7 ^a ±6.9	4.4 ^b ±12.8	9.2 ^{ab} ±9.3	n.s	n.s	n.s
Milk urea > 300 mg/l (% animals)	17 ^a ±13.4	13.5 ^a ±7.8	11.6 ^a ±9.6	14.1 ^a ±9.4	n.s	n.s	n.s
FPR < 1 (% animals)	21.3 ^{ab} ±11.3	10.7 ^a ±6.9	22 ^b ±12.8	17.4 ^{ab} ±9.3	0.02	n.s	n.s
Dystocia	20.5 ^a	20.3 ^a	12.1 ^a	17.3 ^a	n.s	0.02	n.s
lactations (no.)	3.6 ^a ±0.5	3.2 ^{ab} ±0.6	3.1 ^{ab} ±0.5	2.4 ^b ±0.4	0.03	<0.01	n.s
% Milk out of roughage	48.6 ^a ±13.4	43.3 ^a ±20.2	26.9 ^b ±13.0	29.8 ^b ±10.6	n.s	<0.01	n.s

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