Table 1. Nutritional composition of kelp meal fed in the study (mean ± standard deviation)

Item	
Dry matter (DM), % of fresh matter	85.4 ± 0.38
Crude protein (CP), % of DM	8.30 ± 0.39
Soluble CP, % of CP	32.0 ± 13.9
Neutral detergent fiber, % of DM	49.5 ± 3.68
Acid detergent fiber, % of DM	39.1 ± 0.86
Lignin, % of DM	18.5 ± 1.89
Crude fat, % of DM	3.60 ± 0.42
Ash, % of DM	24.5 ± 0.48
Ca, % of DM	1.19 ± 0.02
P, % of DM	0.16 ± 0.005
Mg, % of DM	0.84 ± 0.001
K, % of DM	2.37 ± 0.01
Na, % of DM	3.38 ± 0.06
S, % of DM	3.29 ± 0.08
Cl, % of DM	3.30 ± 0.14
Fe, mg/kg of DM	268 ± 52.1
Zn, mg/kg of DM	29.2 ± 0.5
Cu, mg/kg of DM	2.00 ± 0.00
Mn, mg/kg of DM	23.2 ± 1.26
Mo, mg/kg of DM	0.85 ± 0.10
Co, mg/kg of DM	1.46 ± 1.16
Cr, mg/kg of DM	1.62 ± 0.67
Se, mg/kg of DM	0.25 ± 0.01
Iodine, mg/kg of DM	702 ± 71.0

Table 2. Ingredient and chemical composition of the basal diets fed in the study[1]

	Basal diets	
Item	Soybean meal	Canola meal
Ingredient composition, % of the diet dry matter (DM)		
Mixed, mostly legume baleage	25.0	25.0
Mixed, mostly grass baleage	30.0	30.0
Ground corn	28.5	26.0
Canola meal	-	12.5
Soybean meal	10.0	-
Roasted soybean	2.00	2.00
Sugarcane liquid molasses	2.50	2.50
Minerals and vitamins premix[1]	2.00	2.00
Nutrient composition, % of DM unless otherwise noted		
Crude protein (CP)	18.8	18.5
Soluble CP, % of CP	37.2	36.1
Neutral detergent fiber	33.7	37.5
Acid detergent fiber	21.1	24.1
Crude fat	4.82	4.91
Lignin	4.09	6.70
Ash	7.79	8.10
Ca	0.46	0.55
P	0.36	0.43
Iodine, mg/kg of DM	0.44	0.44
NE_L[3], Mcal/kg of DM	1.69	1.59

[1]Ethylenediamine dihydriodide or kelp meal was mixed with 453 g of ground corn and offered to cows twice daily split in 2 meals.

[2]Contained (as-fed basis) 10.7% Ca, 4.0% P, 20.0% Mg, 7.5% S, 0.43% Fe, 1.0% Mn, 1.5 % Zn, 442 mg/kg of Co, 6,600 mg/kg of Cu, 17.6 mg/kg of Se, 5,500 IU/kg of vitamin E, 44 kIU of vitamin 03, and 176 kIU/kg of vitamin A.

[3]NE_L = net energy of lactation.

Table 3. Intake, milk production, and concentration and yield of milk components in organic Jersey cows fed diets consisted of soybean meal (SBM) or canola meal (CM) supplemented with ethylenediamine dihydriodide (EDDI) or kelp meal (KM)

	Treatments					Contrasts ($P > F$)[1]		
Item	SBM+EDDI	SBM+KM	CM+EDDI	CM+KM	SEM	PS	IS	PS × IS
DMI[2], kg/d	20.5	21.0	21.5	21.9	0.84	<0.001	0.10	0.81
Milk production, kg/d	22.3	23.1	21.2	21.7	0.81	<0.001	0.02	0.52
4% FCM production[3], kg/d	26.2	26.7	25.7	26.5	1.06	0.59	0.31	0.84
ECM production[4], kg/d	27.9	28.5	27.4	28.1	1.08	0.50	0.27	0.88
Feed efficiency[5], kg/kg	1.10	1.11	0.98	0.99	0.04	<0.001	0.57	0.92
Milk fat, %	5.14	5.02	5.40	5.49	0.18	0.02	0.93	0.49
Milk fat, kg/d	1.15	1.16	1.15	1.19	0.06	0.78	0.52	0.73
Milk protein, %	3.54	3.50	3.63	3.65	0.06	0.03	0.87	0.53
Milk protein, kg/d	0.79	0.81	0.77	0.79	0.03	0.20	0.20	0.89
Milk lactose, %	4.84	4.83	4.79	4.81	0.01	0.04	0.69	0.38
Milk lactose, kg/d	1.08	1.12	1.02	1.05	0.04	<0.001	0.01	0.71
Milk solids non-fat, %	9.28	9.27	9.37	9.43	0.08	0.06	0.70	0.65
Milk solids non-fat, kg/d	2.06	2.14	1.99	2.04	0.07	<0.01	0.04	0.67
Milk total solids, %	14.5	14.3	14.8	14.9	0.21	0.01	0.98	0.39
Milk total solids, kg/d	3.22	3.31	3.14	3.23	0.13	0.18	0.16	0.94
Milk urea N, mg/dL	12.9	12.9	10.3	10.6	0.51	<0.001	0.83	0.73
Milk SCC,[6] × 1,000 cells	56.2	36.6	42.6	84.9	19.5	0.38	0.56	0.12

[1]PS = protein source (SBM vs. CM diets); IS = iodine source (EDDI vs. KM diets); PS × IS = protein source by iodine source interaction; significance was declared at $P \leq 0.05$ and trends at $0.05 < P \leq 0.10$.

[2]DMI = dry matter intake.

[3]FCM = fat-corrected milk.

[4]ECM = energy-corrected milk.

[5]Feed efficiency = milk production/DMI.

[6]SCC = somatic cells count.

Table 4. Milk and urinary iodine concentration and blood metabolites in organic Jersey cows fed diets consisted of soybean meal (SBM) or canola meal (CM) supplemented with ethylenediamine dihydriodide (EDDI) or kelp meal (KM)

	Treatments					Contrasts ($P > F$)[1]		
Item	SBM+EDDI	SBM+KM	CM+EDDI	CM+KM	SEM	PS	IS	PS × IS
Iodine intake, mg/d	95.7	95.9	96.3	96.4	0.30	<0.001	0.11	0.83
Milk iodine, μg/L	799	652	786	471	54.0	<0.01	<0.001	0.02
Milk iodine, mg/d	17.8	14.9	15.7	10.3	1.08	<0.001	<0.001	0.10
Milk iodine, % of intake	18.2	17.3	16.0	12.0	1.20	<0.001	<0.01	0.08
Serum iodine, ng/mL	634	431	702	457	32.5	0.06	<0.001	0.39
Urinary iodine, μg/L	166	134	211	202	25.0	0.02	0.40	0.63
Urinary iodine, mg/d	4.68	3.34	5.55	4.11	0.53	0.10	<0.01	0.92
Serum TSH[2], μIU/mL	0.40	0.40	0.39	0.39	0.004	0.01	0.25	0.19
Serum total T_3[3], ng/mL	1.18	1.30	1.06	0.98	0.08	0.05	0.31	0.81
Serum total T_4,[4] ng/mL	56.7	59.6	56.9	56.5	3.90	0.69	0.74	0.66
Serum free T_3, pg/mL	3.67	3.40	2.48	3.53	0.62	0.45	0.58	0.35
Serum free T_4, pg/mL	12.3	13.0	14.3	12.6	0.69	0.16	0.42	0.05
Blood urea N, mg/dL	11.3	11.3	9.05	8.97	0.42	<0.001	0.98	0.86
Serum cortisol, ng/mL	21.0	25.0	19.4	23.2	3.00	0.51	0.13	0.99

[1]PS = protein source (SBM vs. CM diets); IS = iodine source (EDDI vs. KM diets); PS × IS = protein source by iodine source interaction; significance was declared at $P \leq 0.05$ and trends at $0.05 < P \leq 0.10$.

[2]TSH = thyroid stimulating hormone.

[3]T_3 = triiodothyronine.

[4]T_4 = thyroxine.

Table 5. Nitrogen intake and urinary excretion of nitrogenous metabolites in organic Jersey cows fed diets consisted of soybean meal (SBM) or canola meal (CM) supplemented with ethylenediamine dihydriodide (EDDI) or kelp meal (KM)

	Treatments					Contrasts ($P > F$)[1]		
Item	SBM+EDDI	SBM+KM	CM+EDDI	CM+KM	SEM	PS	IS	PS × IS
N intake, mg/d	622	635	642	655	24.7	0.01	0.08	0.96
Urinary creatinine, m*M*	3.49	3.69	3.58	3.75	0.21	0.70	0.34	0.90
Urinary volume, L/d	26.9	24.8	26.2	26.0	1.62	0.84	0.40	0.51
Urinary N, g/d	204	191	170	171	14.0	0.05	0.65	0.60
Urinary N, % of N intake	32.7	29.7	26.4	26.0	1.92	0.01	0.38	0.51
Urinary urea N, g/d	118	115	83.9	91.8	7.07	<0.001	0.67	0.39
Urinary urea N, % of total N	58.2	59.5	49.7	51.5	2.24	<0.001	0.51	0.90
Urinary urea N, % of N intake	18.9	17.9	13.0	14.0	0.90	<0.001	0.99	0.27
Urinary uric acid, mmol/d	34.2	38.5	32.4	41.4	3.30	0.84	0.02	0.41
Urinary allantoin, mmol/d	235	223	223	251	18.4	0.61	0.64	0.21
Urinary total PD, mmol/d	270	261	256	292	20.5	0.63	0.43	0.43

[1]PS = protein source (SBM vs. CM diets); IS = iodine source (EDDI vs. KM diets); PS × IS = protein source by iodine source interaction; significance was declared at $P \leq 0.05$ and trends at $0.05 < P \leq 0.10$.

[2]PD = purine derivatives (uric acid + allantoin).