

Part XIV.

Nutritional Composition of Feeds

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For ration formulation, an accurate and precise description of the nutritional composition of feeds is needed. Feed composition varies greatly by plant species, stage of growth, and environmental conditions. Therefore, a good sampling technique and an actual feed analysis is recommended beyond the use of a feed library. This is particularly important for forages.

This chapter describes the main nutritional constituents of the feeds most commonly used in Virginia (**table 1, page 217**). Terms used in the table heading are defined on below.

Definitions of Terms

ADF (% DM) – Acid detergent fiber concentration as a percentage of dry matter.

ADICP (% CP) – (Acid detergent.) Insoluble crude protein concentration as a percentage of crude protein.

ADL (% DM) – Acid detergent lignin concentration as a percentage of dry matter.

Ash (% DM) – Ash concentration as a percentage of dry matter.

CP (% DM) – Crude protein concentration as a percentage of dry matter.

DM (% AF) – Dry matter concentration as a percentage of as-fed.

Fat (% DM) – Fat concentration as a percentage of dry matter.

ME (Mcal/lb) – Metabolizable energy in megacalories per pound of dry matter.

NDF (% DM) – Neutral detergent fiber concentration as a percentage of dry matter.

NE_m (Mcal/lb) – Net energy for maintenance in megacalories per pound of dry matter.

NEg (Mcal/lb) – Net energy for gain in megacalories per pound of dry matter.

NEl (Mcal/lb) – Net energy for lactation in megacalories per pound of dry matter.

RDP (% CP) – Rumen degradable protein concentration as a percentage of crude protein.

RUP (% CP) – Rumen undegradable protein concentration as a percentage of crude protein.

Soluble CP (% CP) – Soluble crude protein concentration as a percentage of crude protein.

Starch (% DM) – Starch concentration as a percentage of dry matter.

Sugar (% DM) – Sugar concentration as a percentage of dry matter.

TDN (% DM) – Total digestible nutrients as a percentage of dry matter.

Table 1. Nutritional composition of feeds.

Feed	DM (% AF)	Ash (% DM)	TDN (% DM)	ME (Mcal/lb)	NE _m (Mcal/lb)	NE _b (Mcal/lb)	NE _l (Mcal/lb)	CP (% DM)	RDP (% CP)	RUP (% CP)	Soluble CP (% CP)	ADICP (% CP)	Fat (% DM)	NDF (% DM)	ADF (% DM)	ADL (% DM)	Starch (% DM)	Sugar (% DM)
Alfalfa, fresh	30.7	6.2	63.0	1.04	0.64	0.38	0.64	23.1	–	–	–	8.7	1.5	37.9	31.4	–	–	–
Alfalfa, haylage	41.0	12.1	63.0	1.04	0.64	0.37	0.64	20.1	–	–	25.2	13.7	2.0	42.5	36.1	6.4	1.9	1.9
Alfalfa, hay	87.0	11.9	55.2	0.90	0.52	0.27	0.52	19.8	–	–	25.2	12.2	1.6	41.7	33.3	6.8	3.0	8.7
Alfalfa, cubes	91.0	12.0	56.0	0.92	0.54	0.28	0.54	18.1	68.8	31.0	39.3	8.2	2.1	45.5	35.4	7.6	1.4	–
Almond, hulls	89.2	8.3	59.1	0.97	0.58	0.32	0.58	5.5	53.1	46.9	40.9	11.5	2.8	39.0	32.7	11.1	2.5	15.1
Bakery co-products	88.9	4.1	91.9	1.51	1.04	0.72	1.04	13.1	66.4	33.4	23.2	5.7	10.0	13.9	7.4	2.0	37.6	6.3
Barley, dry grain	89.7	2.8	84.1	1.38	0.94	0.64	0.94	12.8	49.1	50.8	27.6	2.2	2.2	18.3	7.1	1.8	56.7	10.7
Barley, steam-flaked grain	81.1	2.9	84.0	1.38	0.94	0.64	0.94	12.5	–	–	–	–	2.1	26.3	8.4	–	59.3	–
Barley, silage	33.6	8.7	60.6	1.00	0.60	0.34	0.60	12.1	79.1	20.8	65.3	4.9	3.5	54.8	34.7	4.8	9.2	–
Barley, hay	88.0	8.4	60.2	0.99	0.60	0.34	0.60	11.0	67.1	32.8	44.7	4.1	2.4	56.9	33.9	4.3	5.7	–
Barley, straw	85.1	12.1	48.3	0.80	0.41	0.16	0.41	6.1	–	–	–	0.6	1.0	71.6	50.1	5.2	–	–
Beet pulp, dry	91.5	6.8	66.6	1.10	0.69	0.42	0.69	9.1	46.7	53.2	21.9	7.0	1.1	41.3	26.4	3.9	0.9	8.6
Bermudagrass, fresh	34.9	8.6	57.3	0.94	0.55	0.30	0.55	15.2	67.5	32.4	42.4	6.3	2.8	66.6	36.1	5.0	1.8	–
Bermudagrass, silage	39.0	8.7	55.4	0.91	0.52	0.27	0.52	13.5	70.3	29.7	53.6	8.0	3.2	66.6	40.3	6.4	2.6	–

Table 1. Nutritional composition of feeds. (cont.)

Feed	DM (% AF)	Ash (% DM)	TDN (% DM)	ME (Mcal/lb)	NE _m (Mcal/lb)	NE _s (Mcal/lb)	NE _l (Mcal/lb)	CP (% DM)	RDP (% CP)	RUP (% CP)	Soluble CP (% CP)	ADICP (% CP)	Fat (% DM)	NDF (% DM)	ADF (% DM)	ADL (% DM)	Starch (% DM)	Sugar (% DM)
Bermudagrass, hay	93.0	7.9	56.3	0.93	0.54	0.28	0.54	11.1	58.3	41.6	32.7	5.4	1.9	66.9	35.7	5.4	4.8	5.8
Blood meal	89.6	2.8	74.6	1.23	0.81	0.52	0.81	95.1	25.2	74.6	14.2	21.4	1.2	–	–	–	–	–
Brewers' grains, dry	93.2	4.6	72.0	1.18	0.77	0.49	0.77	25.0	40.3	59.1	17.9	19.3	8.5	52.1	25.4	6.7	5.8	–
Brewers' grains, wet	25.9	4.4	73.9	1.21	0.80	0.23	0.80	28.5	36.2	63.8	11.4	21.8	9.5	50.0	24.3	6.7	4.8	0.5
Bromegrass, silage	42.1	–	55.0	0.90	0.52	0.26	0.52	9.0	–	–	–	11.9	–	71.1	43.1	–	–	–
Bromegrass, hay	88.3	8.8	52.0	0.85	0.47	0.22	0.47	8.3	–	–	24.6	7.4	1.6	65.9	40.3	–	2.6	9.9
Canola, grain	94.7	4.3	109.2	1.80	1.26	0.90	1.26	23.9	62.9	37.0	41.5	11.1	39.8	28.3	22.0	6.4	1.4	–
Canola meal	90.4	7.4	71.1	1.17	0.76	0.48	0.76	40.9	57.5	42.3	32.2	17.4	7.3	30.2	21.4	8.8	1.3	8.8
Citrus pulp, dry	87.7	7.4	70.0	1.15	0.74	0.47	0.74	6.9	59.5	40.3	41.1	5.6	2.4	24.0	20.4	2.5	1.0	–
Corn, dry grain	87.2	1.4	87.6	1.44	0.99	0.68	0.99	8.8	34.6	65.3	21.1	3.1	3.8	9.7	3.6	1.2	72.1	1.8
Corn, high-moisture grain	70.5	1.5	90.4	1.49	1.02	0.71	1.02	8.8	44.6	55.3	30.0	2.5	3.9	9.9	3.7	1.2	71.3	2.2
Corn, steam-flaked grain	80.7	1.3	95.0	1.56	1.08	0.76	1.08	8.5	29.5	70.4	8.2	4.1	3.2	9.0	3.6	1.3	76.2	–
Corn, whole-plant silage	33.1	4.2	67.7	1.11	0.71	0.44	0.71	8.2	74.5	25.4	55.7	3.7	3.3	43.0	25.5	3.2	32.6	4.3
Corn, dry gluten feed	88.9	8.2	80.0	1.31	0.88	0.59	0.88	22.6	63.7	37.1	51.7	8.9	3.3	35.1	11.2	1.9	16.9	2.7

Table 1. Nutritional composition of feeds. (cont.)

Feed	DM (% AF)	Ash (% DM)	TDN (% DM)	ME (Mcal/lb)	NE _m (Mcal/lb)	NE _g (Mcal/lb)	NE _l (Mcal/lb)	CP (% DM)	RDP (% CP)	RUP (% CP)	Soluble CP (% CP)	ADICP (% CP)	Fat (% DM)	NDF (% DM)	ADF (% DM)	ADL (% DM)	Starch (% DM)	Sugar (% DM)
Corn, dry gluten meal	90.4	2.9	87.8	1.44	0.99	0.68	0.99	68.2	30.0	69.7	14.7	15.1	2.4	8.1	4.8	2.3	15.4	0.2
Corn, dry distillers' grains w/solubles	90.0	5.3	89.0	1.46	1.00	0.69	1.00	30.8	32.0	67.9	16.5	27.9	10.7	33.7	16.2	4.9	5.9	1.2
Corn, wet distillers' grains w/solubles	31.4	5.1	98.0	1.61	1.12	0.79	1.12	30.6	29.9	69.9	15.6	26.4	10.8	31.5	15.3	4.7	6.1	0.9
Cottonseed, whole	92.6	4.1	93.0	1.53	1.06	0.74	1.06	22.9	–	–	32.8	22.9	19.5	47.8	42.9	–	2.2	–
Cottonseed, meal	88.6	7.5	69.6	1.15	0.74	0.46	0.74	45.0	57.2	42.7	16.9	14.3	3.9	33.6	23.7	8.5	1.7	–
Cottonseed, hulls	91.3	3.6	42.0	0.69	0.31	0.07	0.31	6.7	29.9	70.1	21.5	17.0	2.7	81.1	65.1	19.3	1.1	–
Feather meal	92.0	2.8	79.1	1.30	0.87	0.58	0.87	91.1	29.2	70.8	10.3	113.6	9.7	–	–	–	–	–
Fescue, hay	88.9	8.4	58.3	0.96	0.57	0.31	0.57	9.2	–	–	–	8.7	2.1	65.0	40.3	30.1	–	–
Fish meal	92.3	20.0	81.9	1.35	0.91	0.61	0.91	66.2	54.9	45.0	25.2	13.2	11.9	–	–	–	–	–
Forage sorghum, fresh	30.6	7.8	60.1	0.99	0.60	0.34	0.60	8.9	65.6	34.3	40.6	5.1	2.2	56.0	34.9	4.0	12.0	–
Forage sorghum, silage	88.7	7.6	58.8	0.97	0.58	0.32	0.58	9.1	62.0	32.0	36.9	5.0	2.1	58.5	36.9	5.0	9.5	–
Forage sorghum, hay	88.7	7.6	58.8	0.97	0.58	0.32	0.58	9.1	62.0	38.0	36.9	5.0	2.1	58.5	36.9	5.0	9.5	–
Forage sorghum x Sudan, fresh	30.6	7.8	60.1	0.99	0.60	0.34	0.60	8.9	65.6	34.4	40.6	5.1	2.2	56.0	34.9	4.0	12.0	–

Table 1. Nutritional composition of feeds. (cont.)

Feed	DM (% AF)	Ash (% DM)	TDN (% DM)	ME (Mcal/lb)	NE _m (Mcal/lb)	NE _s (Mcal/lb)	NE _l (Mcal/lb)	CP (% DM)	RDP (% CP)	RUP (% CP)	Soluble CP (% CP)	ADICP (% CP)	Fat (% DM)	NDF (% DM)	ADF (% DM)	ADL (% DM)	Starch (% DM)	Sugar (% DM)
Forage sorghum x Sudan, silage	31.3	10.2	56.1	0.92	0.54	0.28	0.54	12.3	69.5	30.4	50.5	6.5	3.3	61.1	39.4	5.6	2.9	5.8
Forage sorghum x Sudan, hay	88.8	8.8	56.8	0.93	0.55	0.29	0.55	11.0	64.8	35.2	39.3	4.5	2.0	62.7	38.4	4.8	2.9	12.6
Pearl millet, fresh	36.2	–	52.5	0.86	0.48	0.23	0.48	12.2	–	–	43.7	8.0	–	65.3	34.5	–	–	–
Pearl millet, silage	34.9	11.8	53.0	0.87	0.49	0.24	0.49	12.3	68.0	31.9	47.7	6.3	2.3	61.9	40.3	6.0	3.6	–
Pearl millet, hay	86.3	11.4	52.5	0.86	0.48	0.24	0.48	9.5	60.2	39.6	36.8	5.7	1.7	62.5	37.7	6.5	2.9	–
Molasses (beet)	–	27.2	75.0	1.23	0.81	0.53	0.81	10.9	–	–	–	–	–	–	–	–	–	70.6
Molasses (cane)	66.0	12.2	72.0	1.18	0.77	0.49	0.77	8.6	–	–	–	–	1.9	–	–	–	12.0	60.0
Oats, dry grain	89.9	3.1	83.0	1.36	0.92	0.62	0.92	12.6	43.5	56.5	27.4	4.3	6.2	26.7	13.3	3.0	44.1	–
Oats, fresh	29.6	9.7	61.1	1.00	0.61	0.35	0.61	16.5	73.4	26.4	50.9	5.6	3.7	52.7	34.0	4.2	2.7	–
Oats, silage	33.8	9.8	58.0	0.95	0.56	0.30	0.56	12.7	77.5	22.4	63.4	5.5	3.7	58.9	38.5	5.3	3.1	–
Oats, hay	89.6	7.1	59.9	0.99	0.60	0.33	0.60	8.7	65.9	33.9	44.8	3.7	2.2	59.1	37.1	4.7	4.0	–
Oats, straw	84.2	6.9	44.3	0.73	0.35	0.10	0.35	4.8	–	–	53.0	1.9	1.3	73.8	49.3	7.1	1.4	–
Orchardgrass, hay	91.5	10.5	56.2	0.92	0.54	0.28	0.54	13.8	–	–	–	8.1	2.3	57.4	36.7	6.0	–	–
Peanut, hulls	93.4	3.8	42.8	0.70	0.32	0.08	0.32	9.5	47.0	52.5	24.5	19.5	1.2	68.5	58.9	23.0	1.2	–

Table 1. Nutritional composition of feeds. (cont.)

Feed	DM (% AF)	Ash (% DM)	TDN (% DM)	ME (Mcal/lb)	NE _m (Mcal/lb)	NE _s (Mcal/lb)	NE _l (Mcal/lb)	CP (% DM)	RDP (% CP)	RUP (% CP)	Soluble CP (% CP)	ADICP (% CP)	Fat (% DM)	NDF (% DM)	ADF (% DM)	ADL (% DM)	Starch (% DM)	Sugar (% DM)
Peanut, meal	94.1	5.6	80.8	1.33	0.89	0.60	0.89	44.9	71.8	28.2	29.8	12.5	7.7	19.9	13.2	3.3	6.9	–
Rye, dry grain	89.9	1.8	80.8	1.33	0.90	0.60	0.90	11.3	77.1	22.5	46.5	1.4	1.4	15.4	7.5	1.6	58.3	–
Rye, fresh	33.0	10.2	65.1	1.07	0.67	0.40	0.67	18.7	74.3	25.6	49.1	5.8	4.0	51.7	32.0	3.7	1.9	–
Rye, silage	36.8	10.1	59.6	0.98	0.59	0.33	0.59	14.6	76.1	23.8	60.5	5.8	3.9	57.7	37.5	4.8	1.6	1.5
Rye, hay	90.4	9.6	63.7	1.05	0.65	0.39	0.65	18.7	66.5	33.3	35.6	6.1	3.4	51.5	30.9	4.3	2.3	–
Sorghum, dry grain	88.7	2.1	86.0	1.41	0.96	0.66	0.96	11.6	28.6	71.1	19.5	8.9	3.5	7.2	4.6	1.2	71.2	0.1
Sorghum, high-moisture grain	69.9	2.7	86.0	1.41	0.96	0.66	0.96	10.4	–	–	3.5	9.3	3.5	9.3	5.5	–	72.9	–
Sorghum, steam-flaked grain	81.0	1.4	93.0	1.53	1.06	0.74	1.06	10.1	–	–	–	82.2	2.6	9.7	6.3	–	75.2	–
Sorghum, silage	36.5	10.1	59.0	0.97	0.58	0.32	0.58	9.2	–	–	3.8	9.0	2.4	49.2	31.1	5.6	4.6	2.5
Sorghum, hay	84.8	11.0	54.5	0.90	0.51	0.25	0.51	9.0	–	–	38.5	8.4	1.6	56.4	36.5	2.9	7.3	–
Soybean, whole	92.9	5.5	91.0	1.50	1.03	0.71	1.03	40.0	71.0	29.0	53.0	10.6	20.6	18.0	10.8	1.9	1.0	–
Soybean, roasted	93.3	5.6	97.4	1.62	1.11	0.79	1.11	40.5	56.3	43.6	16.7	9.8	21.0	21.8	11.5	2.2	1.3	–
Soybean, extruded	92.5	6.2	91.9	1.51	1.04	0.73	1.04	44.4	57.8	42.2	24.7	6.2	13.1	16.6	10.9	1.8	1.3	–
Soybean, hulls	90.0	5.1	62.6	1.03	0.64	0.37	0.64	12.4	46.8	53.1	30.5	6.4	2.3	64.8	46.4	2.47	1.1	2.2

Table 1. Nutritional composition of feeds. (cont.)

Feed	DM (% AF)	Ash (% DM)	TDN (% DM)	ME (Mcal/lb)	NE _m (Mcal/lb)	NE _g (Mcal/lb)	NE _l (Mcal/lb)	CP (% DM)	RDP (% CP)	RUP (% CP)	Soluble CP (% CP)	ADICP (% CP)	Fat (% DM)	NDF (% DM)	ADF (% DM)	ADL (% DM)	Starch (% DM)	Sugar (% DM)
Soybean, high-protein meal	89.2	7.4	79.5	1.31	0.88	0.58	0.88	52.9	70.4	29.5	44.1	10.2	1.9	11.3	7.5	1.2	2.0	13.3
Soybean, low-protein meal	91.7	6.4	81.1	1.33	0.90	0.60	0.90	46.5	55.9	44.1	19.5	9.0	8.3	18.8	10.9	1.5	5.1	11.6
Soybean, heated meal	89.8	6.6	79.3	1.30	0.87	0.58	0.87	48.9	50.5	49.4	13.1	10.8	8.3	22.7	10.9	1.8	1.3	–
Sudangrass, fresh	30.9	10.9	54.8	0.90	0.51	0.26	0.51	12.9	67.0	32.8	42.7	5.7	3.0	61.0	37.3	4.7	2.1	–
Sudangrass, silage	31.3	12.0	53.5	0.88	0.45	0.24	0.45	12.1	70.2	29.7	51.9	6.6	3.1	62.3	40.8	5.8	1.8	0.8
Sudangrass, hay	89.0	9.3	54.5	0.90	0.51	0.26	0.51	8.3	57.9	42.0	34.6	4.1	1.6	65.8	41.1	5.1	1.6	–
Switchgrass, hay	94.2	3.4	46.1	0.76	0.38	0.13	0.38	3.4	–	–	–	8.8	1.2	81.1	46.7	6.6	–	–
Teff, hay	88.0	10.5	45.0	0.74	0.36	0.11	0.36	10.7	–	–	–	16.9	1.1	66.4	38.0	–	–	–
Timothy, hay	87.8	8.5	57.0	0.94	0.55	0.29	0.55	9.4	–	–	–	–	1.9	63.8	38.0	–	–	14.2
Triticale, dry grain	88.8	2.0	82.7	1.36	0.92	0.60	0.92	12.1	67.3	32.6	30.2	2.5	1.7	14.1	4.5	1.8	61.0	–
Triticale, fresh	26.0	8.9	61.4	1.01	0.62	0.35	0.62	15.3	77.0	22.7	50.1	4.3	2.9	56.6	34.2	3.5	1.7	0.8
Triticale, silage	33.0	10.7	57.8	0.95	0.56	0.30	0.56	13.9	81.8	18.1	69.7	5.0	3.7	58.6	38.2	4.7	1.9	1.7
Triticale, hay	90.3	8.4	58.5	0.96	0.57	0.31	0.57	11.6	68.9	31.1	45.9	3.5	2.1	57.7	36.7	4.7	5.1	–
Wheat, dry grain	88.9	2.3	86.8	1.43	0.98	0.67	0.98	13.8	64.2	35.6	29.3	2.4	1.9	12.4	4.2	1.5	62.4	8.6

Table 1. Nutritional composition of feeds. (cont.)

Feed	DM (% AF)	Ash (% DM)	TDN (% DM)	ME (Mcal/lb)	NE _m (Mcal/lb)	NE _g (Mcal/lb)	NE _l (Mcal/lb)	CP (% DM)	RDP (% CP)	RUP (% CP)	Soluble CP (% CP)	ADICP (% CP)	Fat (% DM)	NDF (% DM)	ADF (% DM)	ADL (% DM)	Starch (% DM)	Sugar (% DM)
Wheat, steam-flaked grain	83.0	2.0	86.8	1.43	0.97	0.67	0.97	14.4	–	–	–	3.1	1.9	13.6	5.5	–	64.9	–
Wheat, fresh	34.1	8.9	61.7	1.01	0.62	0.36	0.62	15.3	75.5	24.4	52.8	4.5	3.0	54.1	33.0	3.9	4.1	26.3
Wheat, silage	34.1	10.3	59.1	0.97	0.58	0.32	0.58	12.7	82.1	17.8	67.4	5.0	3.4	56.5	36.6	4.8	6.6	1.8
Wheat, hay	89.9	8.2	58.8	0.97	0.58	0.32	0.58	11.1	66.0	33.9	40.3	3.9	2.0	57.9	35.9	4.8	4.7	9.4
Wheat, straw	91.8	7.5	50.0	0.82	0.44	0.19	0.44	5.1	65.4	34.5	40.8	5.0	1.4	73.7	50.2	7.4	1.6	2.5
Wheat, bran	90.1	5.5	71.9	1.18	0.77	0.49	0.77	17.5	64.4	35.7	39.8	3.2	4.3	40.1	13.7	4.2	21.2	–
Wheat, middlings	88.9	5.4	72.9	1.20	0.79	0.51	0.79	18.6	68.2	31.6	40.5	3.4	4.1	38.3	13.2	3.7	25.6	–
Whey, wet	16.6	12.7	80.9	1.33	0.90	0.60	0.90	6.3	96.5	7.0	81.4	2.8	4.0	–	–	–	–	50.6
Whey, dry	93.8	12.7	82.2	1.36	0.91	0.62	0.91	13.9	80.1	23.2	85.6	–	2.0	–	–	–	–	56.1

Source: National Academies of Sciences, Engineering, and Medicine. 2016. Nutrient Requirements of Beef Cattle. 8th revised ed. Washington, DC: The National Academies Press.

