AMINO ACID DIGESTIBILITY AS AFFECTED BY VARIOUS FIBER SOURCES AND LEVELS

2. THE RELATIONSHIP BETWEEN FIBER LEVELS AND AMINO ACIDS DIGESTIBILITY

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Summary

A number of correlation and regression analyses were performed on data from apparent and true digestibility of amino acids at ileal and fecal level with finishing pigs, in order to investigate whether these amino acid digestibilities could be predicted with certainly degree on their fiber fractions content (chemical analysis). The data comprised 16 diets varying in 4 levels of crude fiber and from 4 fiber sources. The relationships between fiber fractions including crude fiber (CF), NDF, ADF lignin and cellulose contents on apparent and true digestibility of almost all amino acids in both ileal and fecal level were negative, except glutamine at fecal level. In apparent digestibility at ileal level, the correlations of fiber fractions were moderate (r of NDF = 0.53 to 0.63; ADF, 0.50 to 0.77; cellulose, 0.50 to 0.75), with an exception of CF content was relatively high (r of 0.58 to 0.81). The correlations to true digestibility of amino acids were weaker. In case of at fecal level, the higher correlation (negative) was found with NDF than CF content. Estimations of amino acids digestibility were performed using regression equation. The data showed that apparent digestibility of amino acids could be estimated for almost amino acids except arginine, threonine, valine and tyrosine at fecal level and phenylalaine, valine and glycine at ileal level. The best prediction at ileal and fecal level (r^2 = 0.55 - 0.77 and 0.52 - 0.76), respectively was obtained with NDF content. Prediction for true digestibility of amino acids, none of fiber fractions could be estimated for arginine, leucine and valine at all collection levels. At ileal level, CF could be used for most of amino acids except phenylalanine, glycine and proline; cellulose, only for lysine and methionine and NDF, only for proline. At fecal level, glutamine digestibility could be estimated only from CF and ADF content. The best predictor at ileal level was ADF content whereas at fecal level was NDF content. These results indicate that lignin content could not be used as predictor for all amino acids at both levels neither in apparent nor true digestibility.

(Key Words: Amino Acid Digestibility, Fiber Levels, Fiber Fractions, Correlation, Prediction Equation, Cannulated Pigs).

Introduction

Fibrous feedstuffs had been reported to reduce the digestibility of nutrients, including protein. Most of studies have been assessed using crude fiber as the component representing dietary fiber. However, depending on the relative contents of other fiber fractions, crude fiber represents only these correlation incorporating into prediction equation, based on chemical analysis parameters. part of the real intake of the animals (Van Soest and McQueen, 1973). Sources and chemical composition of fiber used, as well as method of measurement may play a role in the accuracy estimations of digestibility. Unfortunately, there is limited published evidence relating fiber fractions and amino acids digestibility in fibrous feedstuffs. The information on the fiber content affected protein and amino acids digestibility were reported by Taverner and Farell (1981), in wheat and grains. Kreinbring et al. (1988) evaluated the addition to finishing pig diets of alfalfa, green rye and whole corn plant. Those forages, produced in temperate area, reduced digestibility of protein and amino acid to the terminal ileum and over total tract. The attempt of this study had been made to find out the relationship between fiber fractions and amino acids digestibility and utilized these correlation incorporating into prediction equation, based on chemical analysis parameters.

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Materials and Methods

The data used originated from experiments with finishing pigs (70-90 kg) performed to determine the digestibility of amino acids that have been published (Nongyao et al., 1990). The diets varied in 4 levels of crude fiber (1, 3, 7 and 9%) from alfalfa meal, rubber seed meal, leucaena meal and cellulose. As shown in table 1, the average fiber fractions content of the diets were varied according to added fiber sources. The correlation coefficient (r), degree of determination (r^2) and

TABLE 1. THE COMPOSITION OF FIBER FRACTIONS AT DIFFERENT LEVELS OF CRUDE FIBER (1, 3, 7 AND 9%) ADDED FROM VARIOUS FIBER SOURCES[1]

Component	AFM-series				RSM-series				LM-series			
	1	3	7	9	1	3	7	9	1	3	7	9
Fiber fractions (%)[2]												
CF	1.51	3.83	8.89	11.81	1.35	3.85	5.56	8.15	1.46	4.16	8.90	11.39
NDF	3.94	14.89	17.06	21.49	3.10	10.66	19.66	25.42	9.21	13.80	20.14	22.18
ADF	2.05	5.36	10.48	14.87	1.77	4.09	5.70	11.76	2.17	5.34	12.46	14.19
Lignin	0.31	1.07	1.79	3.16	0.11	0.15	0.37	0.61	0.03	0.71	2.41	2.40
Cell.	1.09	3.07	9.05	10.55	0.27	1.74	4.29	6.53	1.00	3.47	7.83	9.46

[1]Abbreviated: AFM-series, alfalfa meal added to meet 1,3,7 and 9% crude fiber; RSM-series, rubber seed meal added to meet 1,3,7 and 9% crude fiber; LM series, leucaena meal added to meet 1,3 7 and 9% crude fiber; Cell., cellulose.

[2]Analysed values.

TABLE 2. THE CORRELATION (R) BETWEEN FIBER FRACTIONS AND THE APPARENT AMINO ACIDS DIGESTIBILITY AT ILEAL AND FECAL LEVEL

Amino acids	Fiber fractions[1]									
	CF		NDF		ADF		LIG		CELL	
	ile	fec	ile	fec	ile	fec	ile	fec	ile	fec
Indispensable amino acids										
Arg	−.46	−.40	−.57	−.46	−.52	−.47	−.26	.40	−.49	−.38
His	−.63	−.42	−.74	−.61	−.65	−.49	−.39	−.22	−.62	−.40
Ile	−.43	−.52	.61	.65	−.48	−.57	−.25	−.34	−.43	−.52
Leu	−.49	−.67	−.49	−.76	−.51	−.72	−.46	−.56	.50	−.65
Lys	−.61	−.60	−.72	−.70	−.64	−.64	−.36	−.44	−.60	−.58
Met	−.69	−.56	−.74	−.65	−.71	.60	−.47	−.43	−.65	−.54
Phe	−.45	−.55	−.60	−.68	−.51	−.61	−.25	−.38	−.40	−.52
Thr	.60	−.48	−.66	−.64	−.65	−.54	−.46	−.34	−.62	−.47
Val	−.49	−.59	−.45	−.67	.54	.63	−.53	−.54	−.53	−.56
Dispensable amino acids										
Ala	.49	−.24	−.68	.52	−.55	−.32	−.19	−.02	−.46	.22
Asp	−.37	−.33	.59	−.54	.45	.40	−.04	−.09	.34	−.30
Glu	−.71	−.61	−.75	−.70	−.74	−.65	−.51	−.45	−.72	−.59
Gly	−.47	−.51	−.51	−.60	−.49	−.57	−.31	−.40	−.46	−.50
Pro	−.50	−.21	−.61	−.27	−.57	−.23	−.27	−.03	−.51	−.15
Ser	−.66	−.51	−.72	−.69	−.70	.57	−.44	.36	−.66	.50
Tyr	−.41	−.72	−.62	−.76	−.48	−.74	−.19	−.52	−.37	−.67

[1]Abbreviated: CF, crude fiber; NDF, neutral detergent fiber; ADF, acid detergent fiber; LIG, lignin; CELL, cellulose.

regression equation were performed using the SAS (1986) by Proc Reg Procedure. The degree of determination (r^2) values that below 0.50 were omitted for estimating amino acid digestibility in regression equation, as more than 50% of other factors might confound. For improving the degree of certainly, the simple regression was improved using cubic regression model. The fiber fractions, including NDF, ADF, lignin and cellulose contents were determined according to Georing and Van Soest (1970). The representative samples of diets, ileal digesta and feces were determined for amino acid contents using amino acid analyzer model LKB 4150 alpha and chromic oxide concentration by the method of Fenton and Fenton (1979).

Results and Discussion

As shown in table 1, the different fiber fractions based on 1 to 9% crude fiber in the diets were varied, which was the most desirable as background for prediction equation. The simple correlations between fiber fractions in the diets and apparent digestibility of amino acids are given in table 2 and in table 3 for the true digestibility. Almost correlation were negative with an exception of glutamine at fecal level in true digestibility. Statistical analyses of the degree of determination between apparent digestibility of amino acids and fiber fractions are shown in table 4 and for true digestibility in table 5. The best predictor of the apparent digestibility is NDF content either at ileal or fecal level (r^2 range, 0.50 to 0.77 and 0.52 to 0.76), except for arginine, threonine, valine and proline. The second best included CF, ADF and cellulose content. Neither lignin at all levels nor cellulose content at fecal level (with exception of tyrosine) could be used for prediction. In addition, arginine, threonine, valine and proline digestibilities could

TABLE 3. THE CORRELATION (R) BETWEEN FIBER FRACTIONS AND THE TRUE AMINO ACIDS DIGESTIBILITY AT ILEAL AND FECAL LEVEL

Amino acids	Fiber fractions[1]									
	CF		NDF		ADF		LIG		CELL	
	ile	fec	ile	fec	ile	fec	ile	fec	ile	fec
Indispensable amino acids										
Arg	−.27	−.07	−.39	−.18	−.32	−.14	−.04	−.12	−.28	−.08
His	−.43	−.33	−.56	−.54	.46	−.38	−.21	.12	−.43	.29
Ile	−.23	−.47	−.45	−.68	−.28	−.50	−.06	−.24	−.24	−.43
Leu	−.31	−.62	−.35	−.77	−.33	−.66	−.30	−.49	−.34	−.60
Lys	.55	−.45	−.68	.61	−.58	−.49	−.31	−.30	−.55	−.46
Met	−.68	−.45	−.67	−.60	−.70	−.50	−.47	−.32	−.67	−.45
Phe	−.34	−.49	−.49	−.62	−.40	−.54	−.29	−.31	−.29	−.45
Thr	−.29	.44	.36	−.63	−.33	−.48	.35	.29	−.35	−.43
Val	−.49	−.41	−.45	−.60	−.53	−.45	−.52	−.34	−.52	−.39
Dispensable amino acids										
Ala	−.37	−.28	−.57	−.57	−.43	−.34	−.35	−.11	−.35	−.28
Asp	−.34	−.28	−.56	−.52	−.42	−.35	−.03	−.04	−.32	−.26
Glu	−.53	.60	−.61	.41	−.56	.58	−.34	.56	−.56	.53
Gly	−.12	−.42	−.06	−.54	−.09	.46	−.003	−.30	−.10	.40
Pro	−.62	−.17	−.61	.25	−.62	−.19	−.32	.01	−.56	−.11
Ser	−.56	−.50	−.62	−.68	−.60	−.55	−.377	−.33	−.57	−.48
Tyr	−.43	−.67	−.65	−.75	−.47	−.68	−.19	−.44	.40	−.63

[1]Abbreviated: CF, crude fiber; NDF, neutral detergent fiber; ADF acid detergent fiber; LIG, lignin; CELL, cellulose.

TABLE 4. THE DEGREE OF DETERMINATION (R^2) OF DIFFERENT FIBER FRACTIONS AND THE APPARENT DIGESTIBILITY OF AMINO ACIDS AT ILEAL AND FECAL LEVEL

Amino acids	Fiber fractions[1]									
	CF		NDF		ADF		LIG		CELL	
	ile	fec	ile	fec	ile	fec	ile	fec	ile	fec
Dietary indispensable amino acids										
Arg	.60	.33	.38	.23	.64	.23	.30	.19	.56	.32
His	.70	.26	.62	.57	.66	.24	.26	.13	.65	.20
Ile	.52	.34	.43	.53	.52	.33	.22	.22	.53	.28
Leu	.43	.51	.51	.62	.41	.52	.33	.43	.45	.44
Lys	.72	.38	.60	.61	.68	.41	.24	.34	.64	.34
Met	.58	.33	.61	.52	.58	.38	.31	.37	.59	.30
Phe	.40	.32	.45	.63	.38	.38	.09	.29	.40	.28
Thr	.71	.32	.50	.45	.69	.29	.35	.19	.67	.23
Val	.35	.35	.33	.45	.38	.40	.40	.40	.39	.33
Dietary dispensable amino acids										
Ala	.63	.33	.61	.50	.62	.20	.17	.01	.61	.23
Asp	.47	.27	.77	.77	.50	.20	.15	.05	.43	.18
Glu	.81	.42	.63	.62	.78	.43	.33	.29	.71	.35
Gly	.43	.32	.45	.50	.39	.32	.15	.28	.39	.25
Pro	.55	.17	.52	.38	.59	.05	.24	.01	.53	.03
Ser	.79	.34	.59	.58	.77	.35	.34	.17	.75	.28
Tyr	.46	.53	.46	.77	.43	.57	.10	.31	.50	.45

[1]Abbreviated: CF, crude fiber; NDF, neutral detergent fiber; ADF, acid detergent fiber; LIG, lignin; CELL, cellulose.

not predict from any fiber fraction contents. The suitability of fiber fractions as a predictor for amino acid digestibilities are summarized in table 6 and table 10. CF content could be predicted only glutamine digestibility at fecal level, but at ileal level more amino acid digestibilities could predict from CF content and probably be the best predictor. None of fiber fractions could be used for estimating true digestibility of arginine, leucine and valine neither at fecal nor ileal level. It was worthy noted that while mostly samples taken at fecal level hardly to use for predicting true amino acid digestibility, glutamine could predict with CF and ADF content with relatively high r^2 (0.71 and 0.77). It was interesting to find that, of the true digestibility of amino acids at fecal level NDF was the most effective to use as a predictor whereas at ileal level, ADF was.

In table 7, the regression equations for apparent digestibility at ileal level of individual amino acid are given. Regression using NDF content had lower r^2 (0.53 to 0.63) than regression based on cellulose content (0.50 to 0.75) and ADF content (0.50 to 0.77), respectively. All fiber fractions except lignin could be used for predicting amino acid digestibility with confidence. The CF, NDF, ADF and cellulose content could be used to elucidate up to 10 amino acids with the exception of phenylalanine, valine and glutamine.

In case of the influence of fiber fractions from various fibrous feedstuffs on the true digestibility, the regression equations were performed in table 8. Arginine, leucine, phenylalalnine, valine and glycine could not predict the true digestibility from any fiber fraction with confidence as r^2 were lower than 0.50. The amino acids that could be predicted from fiber fractions were smaller in number than in apparent digestibility. CF level could be used up to 10 amino aicds for prediction, r^2 ranged from 0.54 to 0.75. NDF content could

TABLE 5. THE DEGREE OF DETERMINATION (R^2) OF DIFFERENT FIBER FRACTIONS AND THE TRUE DIGESTIBILITY OF AMINO ACIDS AT ILEAL AND FECAL LEVEL

Amino acids	Fiber fractions[1]									
	CF		NDF		ADF		LIG		CELL	
	ile	fec	ile	fec	ile	fec	ile	fec	ile	fec
Dietary indispensable amino acids										
Arg	.17	.28	.41	.04	.22	.20	.18	.07	.17	.25
His	.51	.12	.40	.71	.50	.15	.12	.22	.46	.11
Ile	.52	.28	.23	.55	.49	.30	.17	.23	.51	.29
Leu	.37	.44	.42	.60	.35	.47	.25	.28	.35	.40
Lys	.70	.28	.52	.41	.66	.28	.23	.25	.62	.25
Met	.67	.24	.60	.44	.65	.26	.31	.29	.65	.23
Phe	.27	.24	.41	.74	.26	.29	.03	.30	.08	.22
Thr	.55	.22	.22	.24	.51	.19	.21	.18	.12	.19
Val	.34	.21	.36	.38	.36	.26	.33	.16	.27	.23
Dietary dispensable amino acids										
Ala	.62	.20	.44	.52	.58	.20	.15	.22	.12	.22
Asp	.61	.23	.64	.73	.61	.27	.15	.18	.18	.18
Glu	.74	.77	.41	.34	.69	.71	.23	.49	.49	49
Gly	.09	.18	.16	.42	.07	.21	.27	.18	.18	.18
Pro	.47	.10	.64	.33	.49	.13	.12	.16	.16	.16
Ser	.75	.32	.46	.59	.71	.33	.31	.26	.26	.26
Tyr	.66	.45	.43	.70	.57	.47	.19	.41	.41	.41

[1]Abbreviated: CF, crude fiber; NDF, neutral detergent fiber; ADF, acid detergent fiber; LIG, lignin; CELL, cellulose.

TABLE 6. THE SUITABILITY OF DIFFERENT FIBER FRACTIONS AS PREDICTOR OF THE APPARENT AMINO ACIDS DIGESTIBILITY AT ILEAL AND FECAL LEVEL

Amino acids	Fiber fractions[1]									
	CF		NDF		ADF		LIG		CELL	
	ile	fec	ile	fec	ile	fec	ile	fec	ile	fec
Indispensable amino acids										
Arg	+	–	–	–	+	–	–	–	+	–
His	+	–	+	+	+		–	–	+	–
Ile	+			+	+		–	–	+	
Leu	–	+	+	+	–	+	–	–	–	–
Lys	+	–	+	+	+	–	–	–	+	–
Met	+	–	+	+	+	–	–	–	+	–
Phe		–	–	+	–		–	–	–	–
Thr	+	–	+	–	+	–	–	–	+	–
Val	–	–	–	–	–	–	–	–	–	–
Dispensable amino acids										
Ala	+	–	+	+	+	–	–	–	+	–
Asp	–	–	+	+	+	–	–	–	–	–
Glu	+	–	+	+	+	–	–	–	+	–
Gly	–	–	–	+	–	–	–	–	–	
Pro	+	–	+	–	+	–	–	–	+	–
Ser	+	–	+	+	+	–	–	–	+	–
Tyr	–	+		+	–	+		–	+	–

[1]Abbreviated: CF, crude fiber; NDF, neutral detergent fiber; ADF, acid detergent fiber; LIG, lignin; CELL, cellulose.

[2] + : degree of determination (r^2) more than 0.50
– : degree of determination (r^2) less than 0.50

TABLE 7. RELATIONSHIP BETWEEN APPARENT DIGESTIBILITY OF AMINO ACIDS AND FIBER FRACTIONS (X) FROM VARIOUS FIBROUS SOURCES AT ILEAL LEVEL

Amino acids	Fiber fractions[1]	R^2	Predicted equation			
				X^3	X^2	X
Arg	CF	0.60	90.22	+7.93	2.20	+1.32
	ADF	0.64	89.21	+6.91	−1.50	+0.07
	CELL	0.56	95.77	+4.31	−1.93	+0.14
His	CF	0.70	90.19	+4.60	−2.17	+0.14
	NDF	0.62	76.31	+5.96	0.56	+0.12
	ADF	0.66	90.41	+2.85	−1.24	+0.06
	CELL	0.65	92.53	+1.18	−1.98	+0.16
Ile	CF	0.52	94.82	+0.48	−0.70	+0.05
	ADF	0.52	97.47	−1.30	0.21	+0.01
	CELL	0.53	96.44	−2.20	−0.33	+0.04
Leu	NDF	0.51	82.92	+4.50	−0.42	+0.01
Lys	CF	0.72	94.06	+2.60	−0.96	+0.06
	NDF	0.60	89.82	+2.13	−0.19	+0.003
	ADF	0.68	94.34	+1.69	−0.55	+0.02
	CELL	0.64	95.95	+0.65	−0.77	+0.06
Met	CF	0.58	94.09	+2.37	−1.04	+0.06
	NDF	0.61	87.51	+3.09	−0.28	+0.005
	ADF	0.58	94.80	+1.16	−0.54	+0.02
	CELL	0.59	95.18	+1.41	−1.25	+0.09
Phe	none					
Thr	CF	0.71	86.65	+5.99	−1.74	+0.10
	NDF	0.50	84.56	+2.97	−0.28	+0.006
	ADF	0.69	88.44	+3.55	−0.93	+0.04
	CELL	0.67	91.29	+2.61	−1.45	+0.11
Val	none					
Ala	CF	0.63	86.52	+7.55	2.31	+0.14
	NDF	0.61	92.72	−0.37	+0.06	−0.003
	ADF	0.62	84.50	+6.91	−1.59	+0.07
	CELL	0.61	91.97	+3.26	−2.07	+0.16
Asp	NDF	0.77	111.69	6.86	+0.69	0.02
	ADF	0.50	77.22	+14.04	−2.69	+0.12
Glu	CF	0.81	93.98	+3.50	−1.06	+0.06
	NDF	0.63	92.37	+1.76	−0.16	+0.003
	ADF	0.78	92.29	+2.38	0.60	+0.60
	CELL	0.71	96.55	+1.29	−0.81	+0.06
Gly	none					
Pro	CF	0.55	87.56	+7.97	2.08	+0.12
	NDF	0.52	95.15	−0.30	+0.05	−0.05
	ADF	0.59	87.82	+6.28	−1.33	+0.06
	CELL	0.53	93.97	+.78	−1.75	+0.13
Ser	CF	0.79	88.63	+6.75	−1.84	+0.10
	NDF	0.59	88.62	+2.40	−0.21	+0.004
	ADF	0.77	88.79	+5.16	−1.12	+0.05
	CELL	0.75	93.19	+4.03	−1.74	+0.12
Tyr	CELL	0.50	95.77	+0.98	−1.33	+0.11

[1]Abbreviated: CF, crude fiber; NDF, neutral detergent fiber; ADF, acid detergent fiber; LIG, lignin; CELL, cellulose.

TABLE 8. RELATIONSHIP BETWEEN TRUE DIGESTIBILITY OF AMINO ACIDS AND FIBER FRACTIONS (X) FROM VARIOUS FIBROUS SOURCES AT ILEAL LEVEL

Amino acids	Fiber fractions[1]	R^2	Predicted equation			
				X^3	X^2	X
Arg	none					
His	CF	0.54	87.47	+8.04	−2.47	+0.15
	ADF	0.50	89.03	+5.15	−1.40	+0.07
Ile	CF	0.52	95.75	+1.29	0.84	+0.06
Leu	none					
Lys	CF	0.70	96.66	+1.84	−0.82	−0.05
	NDF	0.52	92.63	+1.78	−0.16	+0.003
	ADF	0.66	96.88	+1.12	0.47	+0.02
	CELL	0.62	98.04	+0.08	−0.62	+0.05
Met	CF	0.67	87.33	+10.59	−2.53	+0.13
	NDF	0.60	82.63	+5.51	−0.45	+0.009
	ADF	0.65	90.20	+6.66	−1.36	+0.06
	CELL	0.65	94.70	+6.68	−2.40	+0.16
Phe	none					
Thr	CF	0.55	89.21	+6.70	−1.78	+0.10
	ADF	0.51	91.97	+3.68	−0.92	+0.04
Val	none					
Ala	CF	0.62	89.17	+7.30	2.19	+0.13
	ADF	0.58	87.75	+6.44	−1.47	+0.07
Asp	CF	0.61	84.36	+12.82	−3.27	+0.19
	NDF	0.64	105.86	−4.03	+0.41	−0.01
	ADF	0.61	80.65	+12.32	−2.36	+0.10
Glu	CF	0.74	95.09	+3.53	−1.04	+0.06
	NDF	0.69	95.45	+2.44	−0.06	+0.03
Gly	none					
Pro	NDF	0.64	124.99	−3.64	+0.37	- 0.01
Ser	CF	0.75	90.63	+6.97	−1.83	+0.10
	NDF	0.71	91.37	+4.95	−1.08	+0.05
Tyr	CF	0.66	112.38	−2.48	−0.68	+0.06
	NDF	0.57	110.19	−1.36	−0.48	+0.03

[1]Abbreviated: CF, crude fiber; NDF, neutral detergent fiber; ADF, acid detergent fiber; LIG, lignin; CELL, cellulose.

TABLE 9. RELATIONSHIP BETWEEN APPARENT AND TRUE DIGESTIBILITY OF AMINO ACIDS AND FIBER FRACTIONS (X) FROM VARIOUS FIBROUS SOURCES AT FECAL LEVEL.

Amino acids	Fiber fractions[1]	R^2	Predicted equation		
			X^3	X^2	X
		Apparent digestibility			
Arg	none				
His	NDF	0.57	73.75		+3.48	−0.18
Ile	NDF	0.53	88.19		+1.01	−0.06
Leu	CF	0.51	87.56	+3.07	−0.84	+0.04
	NDF	0.62	92.60		+0.05	−0.02
	ADF	0.52	93.23	−1.08	+0.01	+0.01
Lys	NDF	0.61	90.08		+0.97	−0.06
Met	NDF	0.52	84.82		+1.32	−0.09
Phe	NDF	0.63	83.07		+2.52	0.14
Thr	none					
Val	none					
Ala	NDF	0.50	111.35	−8.11	+0.69	0.01
Asp	NDF	0.77	125.84	−12.76	+1.22	−0.03
Glu	NDF	0.62	97.08	−0.78	+0.07	−0.003
Gly	NDF	0.50	81.19	+1.02	−0.04	−0.001
Pro	none					
Ser	NDF	0.58	101.09	−3.07	+0.25	−0.07
Tyr	CF	0.53	89.96	+0.68	−0.28	+0.01
		True digestibility			
Arg	none					
His	NDF	0.71	128.93	13.37	+1.23	−0.03
Ile	NDF	0.55	101.36	−2.10	+0.17	−0.005
Leu	NDF	0.60	100.89	−1.48	+0.08	−0.002
Lys	none					
Met	none					
Phe	NDF	0.74	125.87	−10.87	+0.98	0.02
Thr	none					
Val	none					
Ala	NDF	0.52	121.84	−8.25	+0.63	0.01
Asp	NDF	0.73	125.17	−11.47	+1.08	−0.02
Glu	CF	0.77	90.85	+5.44	−1.52	+0.10
	ADF	0.71	91.11	+4.28	−0.98	+0.05
Pro	none					
Ser	NDF	0.59	106.34	−3.61	+0.29	−0.008
Tyr	NDF	0.70	104.52	−2.61	+0.21	−0.006

[1]Abbreviated: CF, crude fiber; NDF, neutral detergent fiber; ADF, acid detergent fiber; LIG, lignin; CELL, cellulose.

TABLE 10. THE SUITABILITY OF DIFFERENT FIBER FRACTIONS AS PREDICTIOR OF THE TRUE AMINO ACIDS DIGESTIBILITY AT ILEAL AND FECAL LEVEL

Amino acids	Fiber fractions[1]									
	CF		NDF		ADF		LIG		CELL	
	ile	fec	ile	fec	ile	fec	ile	fec	ile	fec
Indispensable amino acids										
Arg	–	–	–	–	–	–	–	–	–	–
His	+	–	–	+	+	–	–	–	–	–
Ile	+	–	–	+	–	–	–	–	–	–
Leu	–	–	–	+	–	–	–	–	–	–
Lys	+	–	+	–	+	–	–	–	+	–
Met	+	–	+	–	+	–	–	–	+	–
Phe	–	–	–	+	–	–	–	–	–	–
Thr	+	–	–	–	–	–	–	–	–	–
Val	–	–	–	–	–	–	–	–	–	–
Dispensable amino acids										
Ala	+	–	–	+	+	–	–	–	–	–
Asp	+	–	+	+	+	–	–	–	–	–
Glu	+	+	–	–	+	+	–	–	–	–
Gly	–	–	–	–	–	–	–	–	–	–
Pro	–	–	+	–	–	–	–	–	–	–
Ser	+	–	–	+	+	–	–	–	–	–
Tyr	+	–	–	+	+	–	–	–	–	–

[1]Abbreviated: CF, crude fiber; NDF, neutral detergent fiber; ADF, acid detergent fiber; LIG, lignin; CELL, cellulose.

[2] + : degree of determination (r^2) more than 0.50
– : degree of determination (r^2) less than 0.50

be evaluated up to 7 amino acids with r^2 ranging from 0.52 to 0.71. ADF content could be elucidated up to 6 amino acids with r^2 ranging from 0.50 to 0.66 whereas cellulose content could be estimated only for lysine and methionine digestibilities.

At fecal level, the regression equations for both in apparent and true digestibility of amino acids are shown in table 9. Arginine, threonine, valine and proline could not predict in neither apparent nor true digestibility. Lysine and methionine could not predict for true digestibility from any fiber fraction.

In conclusion, results of regression analyses indicated a moderate relationship between fiber fractions and apparent amino acid digestibilities, with an exception of CF which had relatively high degree of determination. The relationships for true digestibility of amino acids were poorer. At fecal level, NDF had higher correlation than other fiber fractions, whereas at ileal level, ADF was. The data suggested that lignin content could be used in neither apparent nor true digestibility at both levels.

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