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Effect of supplementation of L-arginine during early and late gestation on nutrient digestibility of large white Yorkshire sows

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Abstract
The present study was conducted to assess the effect of supplementation of L-arginine during early and late gestation on nutrient digestibility of Large White Yorkshire (LWY) sows. Twenty four sows were selected at the day of breeding and randomly distributed into four dietary treatment groups *viz*., a control group (A) receiving un-supplemented basal diet throughout the gestation, late supplemented group (B) receiving 1 per cent L-arginine during last thirty days of gestation, early supplemented group (C) receiving 1 per cent L-arginine during first thirty days of gestation and combined group (D) receiving 1 per cent L-arginine during first and last thirty days of gestation. A digestibility trial of three-day duration was conducted from 105-107th days of gestation. Nutrient digestibility and estimated total digestible nutrients were similar among all treatment groups. Supplementation of 1 per cent L-Arginine during early and late gestation to sows was observed not to influence the digestibility of any nutrients.

Keywords: L-arginine supplementation, gestation, nutrient digestibility, sows

1. Introduction
A significant proportion of low-birth-weight piglets are identified as intrauterine growth restricted (IUGR), that develops as a condition where in foetal development does not meet its genetic potential. In pig foetal development, effective vasculogenesis and angiogenesis are vital for maintaining adequate placental blood flow, which supports normal foetal growth and reduces embryonic mortality. Although sexually mature sows can sustain pregnancy with a moderate litter size (around 8.5 live piglets per litter) without additional dietary arginine, owing to their endogenous synthesis of this amino acid (Islas-Fabila *et al*., 2024) [6]. This capacity may be inadequate in highly prolific sows. Favourable effects of supplementing the sow diet with L-arginine has been previously demonstrated, Supplementation during early gestation enhanced embryonic survival, increased litter size, and improved birth weight (Gonçalves *et al*., 2016) [3]. In similar lines supplementation of sow diet during late gestation was reported to decrease the occurrence of stillbirths and low-birth-weight piglets (Nuntapaitoon *et al*., 2018) [10]. Assessment of nutrient digestibility in pregnant sows receiving L-arginine-supplemented diets was essential to determine its influence on the efficiency of nutrient utilization. Variation in digestibility may alter the availability of energy and amino acids necessary for optimal foetal growth and maternal maintenance (Che *et al*., 2019) [2]. Therefore, evaluation of digestibility after supplementation with L-arginine of sow diets was undertook in the present study.

2. Materials and Methods
2.1 Feed preparation
A standard pelleted feed was compounded using all ingredients (Table 1) other than rendered fat at RF Feed Mill under School of Animal Nutrition and Feed Technology (SANFT), Mannuthy, Thrissur. Rendered fat was procured from Meat Technology Unit, KVASU,

Mannuthy. Rendered fat was hand mixed uniformly before daily feeding into the pelleted pig feed at CPPR, Mannuthy to achieve the ingredient composition of un-supplemented basal diet. Ingredient composition of supplemented treatment ration was achieved by hand mixing 1per cent L-arginine to basal diet at the time of feeding.

2.2 Feed analysis
The proximate composition of feed *viz*., moisture, crude protein (CP), crude fibre (CF), ether extract (EE), total ash and nitrogen free extract (NFE) and fibre fractions were analysed (AOAC, 2016) [1].

2.3 Experimental layout
Twenty four sows were selected at the day of breeding and randomly distributed into four groups: a control group (A) receiving un-supplemented basal diet throughout the gestation, late supplemented group (B) receiving 1 per cent L-arginine during last thirty days of gestation, early supplemented group (C) receiving 1 per cent L-arginine during first thirty days of gestation and combined group (D) receiving 1 per cent L-arginine during first and last thirty days of gestation. Table 1 details the specific ingredient composition of each of the two experimental rations. All animals were kept under the similar management conditions prevailing in the farm. All sows were fed as per guidelines of ICAR (2013) [5]. during the experiment. Feeding was done twice daily, once in the morning at 10 AM and later in evening at 3 PM.

Table 1: Ingredient composition of the experimental concentrate mixture* fed to experimental animals

S. No	Ingredients	Percentage	Composition
		Basal diet	L-arginine supplemented diet
1	Yellow Maize	62.5	62.5
2	Soyabean Meal	27	27
3	Wheat Bran	2.5	2.5
4	Rendered Fat	6	6
5	Calcite	0.5	0.5
6	Salt	0.5	0.5
7	Feed supplement*	1	1
	Total	100	100
8	L-arginine	0	1

* Containing DCP - 0.54 kg, Calcite - 0.33 kg Manganese sulphate - 0.002 kg, Ferrous Sulphate - 0.01 kg, Copper Sulphate - 0.001 kg, Zinc Oxide - 0.015 kg, Magnesium oxide -0.08kg, Zinc Sulphate - 0.015 kg, Vitamin AB2D3 - 0.003 kg, Vitamin BE - 0.003 kg, Lysine - 0.0006 kg. Methionine 0.0004 kg per kilogram of feed supplement

2.4 Digestibility trial
A digestibility trial of three days duration was conducted before farrowing among all animals by total collection method. Feed offered, refusals and faeces voided were accurately weighed and same were pooled, mixed thoroughly and representative sub samples taken for storage in deep freezer (-20°C) for further analysis during this period. Chemical composition of faecal samples were analysed as per methods described in Association of Official Analytical Chemists (AOAC, 2016) [1]. Total digestible nutrients were calculated from the above data.

2.5 Statistical analysis
Data obtained on the milk parameters during the course of the experiment were analysed statistically as per Snedecor and Cochran (1994) [11] by using the software statistical programme for social sciences (SPSS) version 24.0.

3. Results and Discussion
3.1 Chemical composition of feed
The per cent composition of the concentrate mixture fed to the experimental animals are given in Table 2.

Table 2: Chemical composition[1*] of experimental diet fed to sows, %

Nutrients	Experimental diet
Dry matter	90.24 ± 0.31
Crude protein	18.04 ± 0.04
Ether extract	8.96 ± 0.07
Crude fibre	3.92 ± 0.05
Total ash	4.70 ± 0.04
Nitrogen free extract	64.17 ± 0.05
Acid insoluble ash	0.68 ± 0.04
Calcium	0.60 ± 0.02
Phosphorous	0.44 ± 0.02

[1]Mean of six values with SE, *On dry matter basis except DM

3.2 Chemical composition of faecal matter of experimental animals
Chemical composition of faecal matter of sows receiving four experimental diets *viz*., A, B, C and D had a per cent dry matter of 35.62, 36.30, 35.76 and 35.25 respectively. The values were comparable with the values obtained by Mathew *et al.* (2025) [9] that varied from 34.14 to 35.07. Ether extract values in the present study ranged from 14.11 to 14.46 per cent. The values were similar to values reported by Mathew *et al.* (2025) [9] that was within the range of 15.99 to 18.96. The detailed data on chemical composition are given in Table 3.

Table 3: Chemical composition* of faecal samples of sows maintained on four dietary treatments, %

Parameters	Dietary treatments[1]			
	A	B	C	D
Dry matter	35.62±0.38	36.30±0.39	35.76±0.27	35.25±0.27
Crude protein	13.27±0.64	12.46±0.77	12.89±0.67	12.71±0.72
Ether extract	14.46±0.38	14.24±0.44	14.11±0.26	14.39±0.32
Crude fibre	8.92±0.31	9.03±0.55	9.31±0.54	9.18±0.50
Total ash	20.67±0.45	20.48±0.67	20.56±0.83	21.06±0.71
Nitrogen free extract	42.67±0.86	43.78±1.12	43.13±1.07	42.65±0.65
Acid insoluble ash	10.73±0.83	11.45±0.80	11.11±0.72	11.11±0.43
Calcium	1.65±0.07	1.68±0.09	1.64±0.05	1.68±0.08
Phosphorus	2.10±0.04	2.08±0.07	2.06±0.06	2.07±0.07

[1]Mean of six values with SE, *On dry matter basis except DM

3.3 Apparent digestibility of nutrients of sows maintained on four dietary treatments, %
Digestibility coefficients of nutrients were calculated for sows maintained under four dietary treatment groups (Table 4). The dry matter digestibility was statistically similar among treatment groups. The values obtained were 86.35, 85.33, 86.09 and 85.81 in A, B, C and D respectively. Lokhande (2020) [7] had documented similar values in dry matter digestibility coefficient ranging from 86.76 to 87.59. There was no difference in crude protein digestibility coefficients among treatment groups *viz*., A, B, C and D and was 89.99, 89.96, 90.02 and 90.01 respectively. The values were higher than the values obtained by Mathew *et al.* (2025) [9] ranging from 83.40 to 86.15. The ether extract digestibility was similar among treatment groups and ranged from 77.22 to 77.84 in present study. Lokhande (2020) [7] documented ether extract digestibility ranging from 59.45 to 67.64 among pregnant sows. Thiruveni (2003) [12] reported a higher ether

extract digestibility ranging from 84.13 to 90.30. Lowell *et al.* (2015) [8] studied the digestibility of energy and nutrients in sow diet. They observed apparent total tract digestibility of gross energy as 88.23 percent and digestibility of crude protein as 80.90 per cent. They also reported the digestible energy on dry matter basis was 18.82 MJ/kg and Metabolizable energy on dry matter basis was 15.35 MJ/kg. Crude fibre digestibility was similar among treatment groups ranging from 66.16 to 69.04. Holt *et al.* (2006) [4] studied the effect of high fibre diet on nutrient digestibility in gestating sows and observed that sows receiving a high fibre diet showed reduced digestibility of dry matter, energy and nitrogen ($p < 0.05$).

Table 4: Apparent digestibility of nutrients of sows maintained on four dietary treatments, %

Parameters	Dietary treatments[1]				p value
	A	B	C	D	
Dry matter	86.35±0.78	85.33±0.33	86.09±1.00	85.81±0.34	0.743[ns]
Crude protein	89.99±0.68	89.86±0.66	90.02±0.97	90.01±0.57	0.998 [ns]
Ether extract	77.84±1.70	76.72±0.55	78.13±1.50	77.22±0.52	0.840 [ns]
Crude fibre	69.04±1.82	66.16±2.36	67.53±1.44	66.68±2.26	0.761 [ns]
Nitrogen free extract	90.94±0.50	89.98±0.38	90.64±0.74	90.56±0.27	0.603 [ns]

[1]Mean of six values with SE; ns- non significant ($p>0.05$)

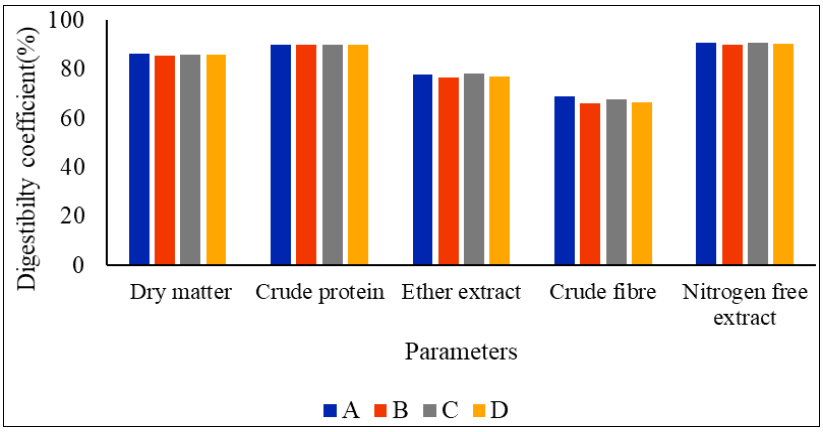

Fig 1: Apparent digestibility of nutrients of sows maintained on four dietary treatments, %

3.4 Estimated total digestible nutrients of sows maintained on four dietary treatments, %

Estimated digestible nutrients were calculated and presented in Table 5. They were similar among treatment groups for values of DCP, DEE, DCF, DNFE per cent

Table 5: Estimated total digestible nutrients of sows maintained on four dietary treatments, %

Parameters	Dietary treatments[1]				p value
	A	B	C	D	
DCP (%)	16.23 ± 0.12	16.21 ± 0.12	16.24 ± 0.17	16.24 ± 0.10	0.998[ns]
DEE (%)	6.97 ± 0.15	6.87 ± 0.04	7.00 ± 0.13	6.92 ± 0.05	0.840[ns]
DCF (%)	2.71 ± 0.07	2.59 ± 0.09	2.64 ± 0.06	2.61 ± 0.09	0.761[ns]
DNFE (%)	58.36 ± 0.32	57.74 ± 0.25	58.16 ± 0.47	58.12 ± 0.18	0.603[ns]

[1]Mean of six values with SE, ns- Non significant ($p>0.05$)

4. Conclusion

Nutrient digestibility and estimated total digestible nutrients were similar among all treatment groups. Supplementation of 1 per cent L-Arginine during early and late gestation to sows was observed not to influence digestibility of any nutrient that were analysed.

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Conflict of Interest

Not available

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