Research On Processing And Utilization Of Rubber Seed For Pig Feeding

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ABSTRACT

Vietnam has around 150.000 tons of rubber seed which is wasted since rubber seeds contain high level of Cyanure causing poison to animal. The objective of the study was to find out the optimal processing method to eliminate HCN in the seed, to determine the digestibility of nutrients and using them in pig diet. The result showed that the optimal processing method was to de-hull, de-fat, homogenize in water (ratio between rubber seed cake and water was 1:5 by weight) then sundry or dry in drier. This method eliminated almost the whole HCN (98%) in rubber seed meal. The digestibility of dry matter, energy; essential, nonessential and total amino acids of diets containing processed rubber seed meal were 91%; 88-89%; 67-73%; 82-87% and 73-78% of those of diets compared to diet containing soybean meal. Processed rubber seed meal could be replaced soybean meal in pig's diet. When the inclusion of processed rubber seed meal in diet increased, the weight gain decreased and feed conversion ration increased. It could be used up to 20% processed rubber seed meal in fattening pig diet.

Keywords: Rubber seed meal, processing method, HCN, digestibility, dry matter, energy, amino acid

1. BACKGROUND

Processing and utilization of available local feedstuff resources have an especially importan signification for reducing feed cost. Rubber seed (RS) and rubber seed meal (RSM) is a suitable choice for above-mentioned purpose. With 510,000 ha of rubber, Vietnam annually obtains approximately 153,000 tons of seed, equivalent to 70,000 tons of RSM. De-hull rubber seeds contain high content of fat (41,2%, Joachim, 2002). Ong & Radem (1981) reported that pig fed with diet of 30% RSM gained the same result compared to diet with soybean meal. Nwokolo (1990) indicated that RSM is a protein-rich feed which can supply essential amino acids for pigs. In Vietnam, rubber seeds have been wasted or collected for fire. The reason of less use of RS is low content of Methionine and Lysine and due to toxicity of HCN by hydrolysis of cyanure. With the view to use efficiently RD, research on the processing to eliminate HCN, and on effects of RSM to growth and development of pigs is needed.

2. MATERIALS AND RESEARCH METHODS

2.1 Materials

The whole rubber seeds collected one day after falling were kept in refrigerator at 7^{o}C. The seeds then were mannually de-hulled by hammer.

2.2 HCN Analysis methods

HCN content was determined by Yeerongpilly laboratory method (Animal Research Institute, Queensland, Australia).

Experiment 1: Elimination of HCN by heat and drying time. The whole and de-hull RS were grinded and kept in room condition during 30, 60, 90, 120 minutes. They were

then dried at 60^0C in autoclave in 120, 180, 240 minutes.

Experiment 2: Elimination of HCN by normal room condition. Fresh RS were kept in room condition 7 days. The seeds were then finely grinded, kept in room condition during 120 minutes, and dry at 60^0C during 180 and 240 minutes.

Experiment 3: Elimination of HCN by room condition + steeping + drying. RS were kept in room condition 7 days. De-hulling, steeping 3 days with the ratio RS/ water = 1/5. Water was replaced daily. The seed were then dried at 60^0C during 180 minutes.

Experiment 4: Elimination of HCN by optimal time of steeping. Fresh RS were kept in room condition 7 days. De-hulling, steeping during 1, 2 and 3 days with the ratio RS/water = 1/5. Water was replaced dailly. The seeds were then grinded, sun drying 5 days. HCN, crude fat and protein contents were determined for each period

Experiment 5: The effects of heat and water on elimination of HCN.

- Plot 1: whole and de-hull RS ⇒ Steeping ⇒ keeping at 30, 38 and 50 ^{o}C during 18 hrs ⇒ analysing HCN
- Plot 2: whole and de-hull RS ⇒ keeping at 30, 38 and 50 ^{o}C during 18 hrs ⇒ analysing HCN.

Experiment 6*:* Elimination of HCN by oil pressing . RS ➔de-hulling ➔ grinding➔ partial fat extracting in 1 day. Analysis HCN. The rest was sun-dryied 3 days on stainless tray and sample was collected daily for HCN analysis.

Experiment 7: Elimination of HCN by homogeneous sample analysis.

- Check sample: RS cake was sun dried 3 days
- Homogeneous sample: RS cake was homogenized with water by liquidizer at maximum speed during 30 minutes with the ratio RS cake/water = 1/5. The product was filtered by cloth. Analysing HCN of filtered RS sample. The rest was sun-dryied 3 days, and samples were collected daily for HCN analysis.

Experiment 8: Determination of optimal water ratio for homogeneous analysis.

The ratio RS/water =1/10; 1/7,5; 1/5; and 1/2,5 in plot 1, 2, 3 and 4 respectively. Samples were homogenized by liquidizer at maximum speed during 30 minutes. Samples were then filtered by cloth. Analysing HCN of filtered RS samples. The rest was sun-dryied during 3 days, and samples were collected daily for HCN analysis.

Experiment 9: Determining variation of HCN content in fat extracted, homogeneous and sun-dried samples. After grinding, RS was extracted fat and analyzed HCN. The fat extrated sample was homogenized with water (1:5) during 30 minutes and then filtered. The filters was sun-dried 3 days on stainless tray. Sample was collected daily for HCN analysis.

2.3 Determination of digestibility of energy and amino acids in RSM-IAS (produced by IAS), commercial RSM (CRSM) and soybean meal (SM)

Twenty castrated Yorkshire the same age with body weight of 25 kg were ploted into 4 cages and radomizedly numbered for 4 experimental rations. The experiment was CRD with two factors. Ration 1: basic ration (cassava meal) (check ration); Ration 2: ration 1 + soybean meal; Ration 3: ration 1 + RSM-IAS; Ration 4: ration 1 + commercial RSM

All experimental procedures had been followed as feed digestibility experiment.

2.4 Determination optimal proportion of RSM in the ration for fattening pig

Sixty four castrated Yorkshire x Landrace with initial weight of 30 ± 0,68 kg were placed in 8 plots. Pigs were individually fed *at libitum*. Plot T1: check ration (CR) (ration contains maize and SM) Plot T2: CR + 10% RSM-IAS ; plot T3: CR + 20% RSM-IAS; plot T4: CR + 30% RSM-IAS; plot T5: CR + 20% CRSM; plot T6: CR + 30% CRSM; plot T7: check plot (cassava meal, SM); Plot T8. as plot T7 but SM was replaced by 30% of RSM-IAS

3. RESULTS AND DISCUSION

3.1 HCN elimination

- Experiment 1 results showed that drying whole RS at 60^0C during 240 minutes after keepping in room condition 180 minutes gave the best HCN elimination result (76.33%).

- In experiment 2, HCN was rather highly eliminated (79-83%), but HCN level in RS is not safe for pigs yet.

- Results of experiment 3 indicated that steeping and drying at $60\ ^0$ C during 180 minutes had eliminated almost all HCN in RS, in which the entire seeds gave better effect (99% eliminated). Drying by autoclave is however expensive, solution for reducing drying cost therefore is needed.

- Experiment 4 results showed that steeping RS during 2 and 3 days had the same result of HCN elimination. The recommendation is to keep RS in room condition during 7 days - steeping 2 days (water is replaced daily) – sun drying 5 days or drying at 60^0C during 180 minutes.

- In experiment 5, the % of HCN eliminated were low (46% and 51%) in whole and de-hull RS, respectively. In plot 2, HCN eliminated was higher (68%).

- Results of experiment 6 indicated that fat extracting and sun drying 3 days before oil pressing had better result of HCN elimination (488 ± 12.8 ppm) compared to 852 ± 15 ppm of the check.

- Experiment 7 results showed that fat extracting, water homogenizing and then sun drying 3 days had the best result of HCN elimination (268 ± 10,9 ppm) compared to 496 ± 11.7 ppm of the check.

- In experiment 8, level of HCN eliminated in plot 1 and 3 were better and the same (364 and 366 ppm), but the ratio RS/water in plot 3 is lower (1/5) instead of 1/10 in plot 1. Plot 3 is the best choice.

- Results in experiment 9 showed that fat extracting, water steeping and sun drying 7 days gave best result of HCN elimination (20 ± 1.4 ppm) compared to 1,064 ± 9.7 ppm of original sample

3.2 Digestibility of energy and amino acids of RSM-IAS, CRSM and SM

Table 1. Digestibility of nutrients in digestive tract (%)

Diet	Check (1)	30% SM (2)	30% RSM-IAS (3)	30% CRSM (4)
Dry matter	78.82^a	84.24^b	77.41^a	77.77^a
Energy	87.84^a	88.47^a	79.40^b	78.50^b

Figures in the same row with different superscripts are significantly different at P<0.05

Dry matter digestibility (DMD) was highest in diet 2 (30% SM), significant difference with the check. No difference was found for energy digestibility (ED) of diets containing RSM and the check.

Figures in Table 2 showed that DMD and ED in marker method were higher than feces collection excepting CRSM diet. CIAD of essential amino acids in RSM diets was lower than that of SM diet in both methods using Titanium and Barium markers. However no difference was found between RSM diets. CIAD of Methionine and Tryptophan in SM diet were higher than that in RSM one. However, CIAD of Valine, Phenylalanine, Arginine, Isoleucine and Leucine were similar between all diets.

Table 2. Comparison of ED between feces collection (direct) and marker (indirect) methods

Rations	Total feces collected	AIA	Ti	Ba
Energy				
Check	87.80[a]	95.09[b]	94.72[b]	97.45[b]
SM	88.40[a]	94.78[b]	93.61[b]	96.53[b]
RSM-IAS	79.40[a]	86.51[b]	83.59[b]	92.04[c]
CRSM	78.40	80.81	78.72	80.00
Dry matter				
Check	78.80[a]	91.98[b]	91.31[b]	95.73[b]
SM	84.24[a]	93.27[b]	91.69[b]	95.51[b]
RSM-IAS	77.41[a]	85.27[b]	82.46[b]	91.31[c]
CRSM	77.77	80.24	78.05	79.42

Figures in the same row with different superscripts are significantly different at P<0.05

Table 3. Amino acid digestibility in apparent ilium (%)

Item	Titanium				Barium			
	Diets			Difference	Diets			Difference
	SM	RSM-IAS	CRSM		SM	RSM-IAS	CRSM	
Essential amino acids (EAA)								
Arginine	96	90	88	4.6	83	69	55	16.5
Histidine	91[a]	70[b]	76[ab]	8.1	71[a]	26[b]	31[ab]	21.5
Iso-Leucine	94	81	81	7	66	27	25	22.3
Leucine	95	88	87	5.6	69	44	41	17.1
Lysine	84[a]	-55[b]	-12[ab]	62.9	92[a]	56[b]	56[b]	13.8
Methionine	80[a]	16[b]	32[b]	25	79[a]	40[b]	50[ab]	19

Phenylalanine	90	77	74	10.4	67	35	39	19
Threonine	89	81	78	7	65[a]	22[b]	34[ab]	17.9
Tryptophan	90[a]	73[b]	73[b]	8.4	80[a]	39[b]	46[b]	16.9
Valine	91	79	79	6.3	62	51	37	17.2
Average of essential amino acids	90[a]	60[b]	66[b]	10	73[a]	41[b]	41[b]	14.9
Non-essential amino acids (NEAA)								
Aspartic Acid	92[a]	71[b]	81[ab]	9.9	86[a]	75[ab]	67[b]	8.5
Serine	91[a]	76[b]	78[ab]	6.5	76[a]	51[a]	50[a]	14.6
Glutamic Acid	98[a]	83[b]	84[b]	6.8	86[a]	69[ab]	66[b]	9.7
Alanine	94[a]	77[b]	81[b]	6.2	63	41	26	23.1
Tyrosine	89	72	81	8.7	68	25	46	22.7
Cystine	95[a]	78[b]	82[b]	5.7	63[a]	28[b]	46[ab]	15.7
Average NEAA	93[a]	77[b]	81[b]	6.2	63	-17	-3	37
Average total AA	92[a]	68[b]	72[b]	9	69[a]	15[b]	22[ab]	23.6

Figures in the same row with different superscripts are significantly different at P<0.05

CIAD of NAA in SM diet was higher than that of RSM diets in both methods using Titanium and Barium markers. However, CIAD of Tyrosine and Glycine were the same in all diets. Average CIAD value of total AA in RSM diets was lower than that in SM one.

3.3 Determination of optimal RSM in fattening pig diet

Figures in Table 4 indicated that replacing 20% SM by RSM in fatening pig diet had no effect to weight gain. However to the level of 30% RSM, although well processed, in diet had strongly negative effect to weight gain. Figures in Table 4 had also showed that RSM-IAS gave better result, it may due to the use of appropriate processing procedure.

Table 4. Results of experiment pigs

	T 1	**T 2**	**T 3**	**T 4**	**T 5**	**T 6**	**T 7**	**T 8**	**P**
Initial weight (kg)	30.3	30.9	30.5	30.3	30.8	30.5	30.6	30.3	0.68
Weight gain in two periods (g/day)	668[a]	662[a]	657[a]	639[b]	595[d]	566[e]	630[bc]	622[c]	0.001
Feed conversion rate in two periods	2.88[a]	2.91[a]	2.92[ab]	2.97[a]	3.19[d]	3.33[e]	3.05[c]	3.09[c]	0.001
Feed cost/kg weight gained (NVD.000)	15.7[a]	15.9[a]	15.9[a]	16.3[b]	17.5[d]	18.2[e]	16.7[c]	16.9[c]	0.001

Figures in the same row with different superscripts are significantly different at P<0.05

4. CONCLUSIONS AND SUGGESTIONS

- De-hulling – grinding – fat extracting – water homogenizing at the ratio of 1/5 during 30 minutes – filtering – sun drying 4 days to obtain 10% moisture had eliminated 98% HCN in RS.
- Low digestibility of dry matter and energy, low content of EAA, NEAA and total AA in RSM diet compared to SM diet, but RSM is considered as a protein-rich feed recommended for fatening pig.

- Apropriatelly processed RSM can replace 20% of SM in grower and fatening pig diets without effecting weight gain.

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