ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2019; 5(6): 417-419
www.allresearchjournal.com
Received: 11-04-2019
Accepted: 15-05-2019

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Nutritional status of *Simarouba glauca* detoxified oil cake with respect to some author citation

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Abstract
Simarouba glauca oil cake subjected to different detoxification treatments exhibited significant treatment effects on moisture, ash, crude fibre and carbohydrates contents. Methanol treatments increased moisture content, where fermentation increased ash and crude fibre levels. Carbohydrates were increased over the control by acetic acid treatment. These show that detoxification treatments do not affect drastically the nutritional status of the *Simarouba oil* cake.

Keywords: *Simarouba glauca*, detoxified oil, author citation

Introduction
The major emphasis on fuel source, alternate to fossil is bio-fuel (Bio-diesel) derived from renewable sources, the trees/plants yielding good amount of non edible oils (Rao, 2003 and Rao *et al.,* 1999) [13-14]. These oils including that of *Simarouba glauca* are being converted to bio diesel (Joshi and Hirmath, 2000) [7] for use in internal combustion engines. The oil cake which was non edible due to presence of toxic materials (Govindaraju *et al.* (2009) [5], Severen, 1953 [15], Vaughan, 1970 [16], Lassak *et al.*, 1977 [8] and (Pradhan, 1995) [10] was used as manure (Lele, 2010, Bhaskar and Naidu, 2009 and Altenburg *et al.*, 2008) [9, 3, 1]. Further, giving importance to reduction of costs of biodiesel production, experiments have been conducted to detoxify the oil cakes (Rakshit *et al.,* 2008) [12] and make them fit for use as animal feed. Experiments were also conducted earlier on *Simarouba glauca* oil cake (SOC) (Chikara *et al.,* 1998) [4] and reported variations in the toxic, nutritional and other factors in the oil cake based on ecological/ location factors.
Hence studies were conducted to detoxify the oil cake of seeds obtained from plantation in University of Agricultural Sciences, GKVK, Bangalore. It was found that levels of toxic and anti-nutritional factors varied with the treatments. Further nutritional status, of treated oil cake samples, with respect to protein nitrogen, carbohydrates, potassium, phosphorus, crude fibre and ash contents was studied. The present paper deals with results of the studies.

Material and Methods
In order to device a simple and cost effective procedure for complete or partial detoxification of the *Simarouba glauca* oil cake (SOC), different physical and chemical methods were tried in the laboratory. Expeller pressed SOC was finely ground and subjected to ten different physical and chemical treatments as detailed below:

Extraction of residual oil by soxtherm extraction method
Seeds of *Simarouba glauca* DC. were collected from plantation at GKVK and oil and oilcake were extracted.
Known weight of oil cake was extracted to with petroleum ether using Soxtherm Apparatus and residual oil content was expressed as per cent per unit of oil cake.

Estimation of moisture content in oil cake
A known quantity (10 grams) of oil cake sample were dried at 103°C in a thermostatic oven and dry weight was recorded and moisture content was calculated and expressed as per cent (Raghuramulu *et al.,* 2003) [11].

Estimation of ash content in oil cake

Estimation of ash contents by weight was done as per the procedure described earlier (AOAC**,** 1980) [2]. Expressed as per cent of oil cake sample.

Determination of crude fiber in oil cake

Estimation of crude fibre per cent was done as described earlier (AOAC, 1980) [2] and expressed as per cent on weight basis.

Estimation of nitrogen, phosphorus & potassium content in oilcake

Estimation of nitrogen

Estimation of total nitrogen contents was done by acid digestion of oil cake samples, followed by distillation of ammonia and titration against acid as described earlier (AOAC, 1980) [2].

Crude protein was calculated by multiplying the values of total nitrogen by 6.25.

Estimation of phosphorous and potassium

Phosphorus and Potassium in the oil cake samples were determined after diacid digestion following methods described earlier (Jackson, 1973 and AOAC, 1980) [2] using spectrophotometer and flame photometer.

Results and Discussion

Moisture contents were higher reduced by hydrochloric acid and increased by methanol extraction treatments over the control, which may be due to effect of hydrochloric acid and hygroscopicity of residual methanol (Table 1).

Residual oil per cent was significantly reduced by methanol and sodium hydroxide treatments, compared to control, which may be attributed to solubility of oil and also hydrolysis by the alkali. Other treatments also reduced oil contents in treated cake samples, similar results have been reported earlier also.

Carbohydrates (CHO) contents were affected (Table 1) by treatments. Contents were reduced, either partially or drastically as in boiling (30.29%), roasting (27.29%) and fermentation (27.09%) treatments, over the untreated control (30.49%) samples. But acetic acid (40.09%) and hydrochloric acid (38.53%) treated samples were almost on par with each other by exhibiting increased carbohydrates contents. Reduction in carbohydrates in boiling and fermentation treated samples could be attributed to active break down of carbohydrates and energy release. Whereas increase in carbohydrates, by acetic acid and hydrochloric acid treatments may be due to conversion of other constituents into carbohydrates.

Crude fibre (CF) per cent increased in all treated samples. Highest levels recorded (3.82%) in fermented samples, suggest that soluble carbohydrates might have been converted into insoluble crude fibre. But roasting might have helped conversion of carbohydrates into crude fibre to a limited extent. Reported higher level in sodium hydroxide treated sample.

Ash contents, which incorporate inorganic nutrients, also increased in all. However they were reduced by soaking with water and hydrochloric acid treatments to maximum extent, followed by methanol, acetic acid and others, similar results have been reported earlier.

Total nitrogen (Table 2) and calculated crude protein (CP) contents in samples subjected to fermentation and boiling increased (8.03% and 8.02%) over the control (7.85%). But reduced values in methanol extraction (6.88%) samples, suggest partial removal of nitrogenous constituents from the oil cake. There were no drastic reductions in other samples. Similar results are reported earlier (Bhaskar and Naidu, 2009) [3] also.

Potassium the other nutrient was reduced in all treatments. But in samples subjected to boiling, fermentation and soaking with water where there was almost doubling over control. Drastic reduction was observed in methanol extraction and sodium hydroxide treatments. Similar results have been reported earlier.

Phosphorus contents of oil cake samples were reduced by acetic acid, fermentation and soaking in water showing reduction of nutrients. But not much difference was seen in other treatments. However ammonia treated + roasting treatment has increased in to some extent. Similar effects were observed earlier also.

The results shows that there was no drastic reduction in different nutrients, oil, carbohydrates, crude fibre, ash, nitrogen, crude protein, phosphorus, and potassium contents in the treated oil cake samples. These show that the nutritional status of the treated cake samples was not drastically affected, though there was differential effect of different treatments. The variations call for further research in standardizing the detoxification treatments to maintain nutrient levels.

Table 1: Proximate composition of *Simarouba glauca* oil cake in different treatments (per cent)

Si. No.	Treatments	Moisture	Residual oil	Ash	Crude Fibre	Carbohydrates
1	Control	6.22	9.44	3.75	0.66	30.49
2	Boiling	6.27	8.48	3.98	1.04	30.29
3	Roasting	6.80	8.85	3.68	0.78	27.29
4	Autoclaving	7.33	6.85	3.32	0.86	31.59
5	Soaking with water	6.45	6.85	1.44	0.95	34.28
6	Methanol extraction	10.84	5.37	2.64	0.79	37.04
7	Fermentation	5.97	7.00	8.82	3.82	27.09
8	Acetic acid	6.70	5.73	2.14	1.12	40.09
9	NaOH Treatment	8.56	5.52	3.29	1.10	37.28
10	Roasting after Ammonia	5.25	8.44	3.73	1.03	33.99
11	HCl Treatment	5.17	6.27	1.44	0.94	38.53
	F-value	*	*	*	*	*
	S.Em±	0.11	0.05	0.09	0.04	0.08
	CD at 5%	0.32	0.16	0.25	0.10	0.24
	CV%	2.79	1.29	3.48	5.06	0.40

*Significant at 5% level.

Table 2: Nitrogen, phosphorus and Potassium of *Simarouba glauca* oil cake in different treatments (per cent)

Si. No.	Treatments	Nitrogen	Crude Protein (CP)	Phosphorus	Potassium
1	Control	7.85	49.06	0.33	0.74
2	Boiling	8.02	50.12	0.34	1.43
3	Roasting	7.93	49.56	0.39	0.38
4	Autoclaving	7.97	49.81	0.32	0.37
5	Soaking with water	7.95	49.68	0.20	1.11
6	Methanol extraction	6.88	43.00	0.24	0.19
7	Fermentation	8.03	50.18	0.20	1.25
8	Acetic acid	7.15	44.68	0.19	0.31
9	NaOH Treatment	7.13	44.56	0.23	0.20
10	Roasting after Ammonia	7.65	47.81	0.47	0.24
11	HCl Treatment	7.61	47.56	0.32	0.35
	F-Value	*	*	*	*
	Sem±	0.08	0.09	0.01	0.01
	CD at 5%	0.23	0.26	0.02	0.04
	CV%	1.74	0.32	4.12	3.48

*Significant at 5% level

Acknowledgement
I gratefully acknowledge the interest taken by Dr. Kavin Mc Namara financial assistance extended to me by USDA and Ministry of Higher Education of Afghanistan for encouraging me to do Master's Degree in Environmental Science in India. I gratefully acknowledge the keen interest taken by Dr. K. N. Ganeshaiah, Prof. & Head, Dept. of Forestry & Environmental Science, Dr. C. A. Srinivasa Murthy, Prof. & Head, Dept. Soil Science and Mr. H. Surendra, Dept. of Statistics, UAS, GKVK, Bengaluru. But for the help and co-operation of Dr. Vajranabhaiah, S. N., Dr. Chandrika and Mrs. Pavithra, Dept. of Forestry & Environmental Sciences, it would not have been possible to complete my research in time.

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