Small Ruminant Research 126 (2015) 26–33

Contents lists available at ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

Effect of substitution of soybean meal by detoxified karanja cake on diet digestibility, growth, carcass and meat traits of sheep

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ARTICLE INFO

Article history:
Received 17 July 2013
Received in revised form 12 March 2015
Accepted 12 March 2015
Available online 20 March 2015

Keywords:
Biochemical metabolites
Carcass traits
Digestibility
Karanja cake
Sheep

ABSTRACT

The non-conventional karanja cake is rich in protein (around 30% CP) and can be used in livestock feed as a protein source instead of conventional protein supplement cake like soybean meal (SBM), groundnut cake, etc. The present study was carried out to research the effect of partially substituted soybean meal with detoxified karanja cake (dKC) on performance of ram lambs. Twenty-four ram lambs were randomly divided into four groups ($n = 6$) and fed different levels (%) of detoxified karanja cake (0% replacement, control; 25% replacement, dKC-25; 50% replacement, dKC-50 and 75% replacement, dKC-75) in concentrate mixtures for 140 days. dKC was incorporated in the concentrate mixtures at the expense of soybean meal, maize grain and wheat bran at 9, 18 and 29% in dKC-25, dKC-50 and dKC-75, respectively on fresh basis. As the level of karanja in the diet increased, DMI was found to be decreasing significantly. Similar to these effects, N-retention was reduced leading to significant reduction of body weight in high karanja cake replaced groups. Similar trend was observed in OM, CP, and ADF digestilities and reason attributed to increased dietary level of karanja cake. However, detrimental effects were not observed on the levels of total protein, albumin, globulin, serum urea, aspartate aminotransferase (AST) and alanine aminotransferase (ALT) indicating residual ANF present in dKC did not exert any adverse effects. The effects on hot carcass weight, weights of liver and testes are following a decreasing trend while that weight of kidney is increasing with level of karanja in the diet. Our findings highlights that the detoxified karanja cake can be added as replacement of soybean meal (SBM) at low levels. However, higher levels of replacement (above 9 per cent of concentrate mixture) warrant caution due to its adverse effect on studied parameters.

1. Introduction

Karanja (*Pongamia* spp.) is grown in parts of humid tropical regions of Asia and Oceania. The seed contains 20–30% protein, 27–39% oil and a group of furano-flavonoids that constitutes 5–6% by weight of the oil (Bringi and Mukerjee, 1987). In a recent study, large variations were observed in seed size, composition in terms of protein and fat, incriminating factors like karanjin, pongamol and trypsin inhibitor activity (TIA) collected from different regions of Karnataka (Dineshkumar et al., 2011). The seed kernel after extraction of oil is rich in protein (around 30% CP) which can be used in animal and poultry feed as a protein source (Konwar et al., 1987; Vinay and Kanya, 2008). However, raw expeller karanja cake (rKC) is not commonly used as

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http://dx.doi.org/10.1016/j.smallrumres.2015.03.010
0921-4488/

a feed for livestock due to its poor palatability and presence of antinutritional factors (ANFs), *i.e.* furanoflavones like karanjin, pongamol and certain other polyphenolic compounds (Bringi and Mukerjee, 1987; Prabhu et al., 2002) leading to depression in performance of livestock (Srivastava et al., 1990; Nagalakshmi et al., 2011; Panda et al., 2004). Various methods, namely refluxing with 2% HCl (Mandal, 1985) water leaching, solvent extraction, acid and alkali treatment, autoclaving were adopted to improve palatability and nutritive value of detoxify karanja cake. Among all the methods, solvent extraction was found to be more efficient to remove karanjin (Prabhu et al., 2002) and is being commonly used as a method to detoxify karanja cake. Singh et al. (2006) reported that long term feeding of expeller karanja cake or solvent extracted karanja cake had deleterious effects on the nutrient utilization, blood biochemical profile, rumen fermentation pattern, carcass characteristics and manifested clinico-pathological changes in bone and tissues of vital organs. Further studies indicated that inclusion of expeller karanja cake at 12% in complete diets constituting 390 mg karanjin per kg depressed the performance in lambs (Nagalakshmi et al., 2011). Keeping in view the adverse effects exerted by feeding of karanja cake, present study aimed to fill the gaps in scale up of detoxification methodology of karanja cake at industrial scale and its possible utilization in livestock rations replacing soybean cake. The effects on physiological responses in terms of gene expression of LH receptor and IGF-I genes related to testicular function, testicular architecture and hormones was already reported (Dineshkumar et al., 2013). The objective of the particular experiment is to test different levels of detoxified karanja cake in rations of growing lambs based on its effects on intake, digestibility, growth, carcass and meat traits.

2. Materials and methods

2.1. Source of detoxified karanja seed cake (dKC)

Bulk production of detoxified meal required for feeding trial was collected from industrial partners (M/s Ayurvet Pvt. Limited, Baddi, Himachal Pradesh, India and M/s Ganesh Scientific Research Foundation, New Delhi, India). A process was developed to detoxify karanja seeds initially by crushing and removing the oil using hexane. Then the meal was further detoxified by soaking the seeds in aqueous methanol mixture and drying.

2.2. Feed preparation

The requirements of crude protein (CP) and total digestible nutrients (TDN) suggested by Indian Council of Agricultural Research (ICAR, 1998) formed the guidelines for feeding lambs. The required quantities of feed ingredients like finger millet (*Eleusine corocana*) straw, maize (*Zea mays*) grain, soybean (*Glycine max*) meal, wheat (*Triticum aestivum*) bran, mineral mixture and salt were procured from commercial source for the entire duration of the experiment Maize grain and soybean meal were ground in hammer mill and mixed with wheat bran, mineral-vitamin premix and salt in horizontal mixer. Four iso-nitrogenous and iso-caloric concentrate mixtures were prepared by making minor adjustments in the proportions of wheat bran and maize grain were made in the formulation (Table 1).

2.3. Experimental animals and housing

24 ram lambs were used in this experiment (body weight: 13.7 ± 0.5 kg; aged around 6 months) for a period of 140 days in a permanent open type shed having provision for tying the animals in separate enclosures and also feeding trough. Ram lambs were fed individually and reared under hygienic and uniform managerial conditions throughout the experiment. Ram lambs were offered clean water 2–3 times daily for the entire duration. They were dewormed using broad spectrum anthelmentic (albendazole®) at the rate of 10 mg per kg body weight twice at 21 days interval at the beginning of the trial and all the animals were confirmed to be parasite free by faecal examination. Ram lambs were randomly divided into four groups ($n = 6$) and were offered concentrate mixture incorporating dKC as a replacement of SBM. Different levels (%) of karanja cake were fed (0% replacement, control; 25% replacement—9% dKC in concentrate mixture on fresh basis, dKC-25; 50% replacement—18% dKC in concentrate mixture on fresh basis, dKC-50 and 75% replacement—29% dKC in concentrate mixture on fresh basis, dKC-75). dKC was incorporated in concentrate mixtures (on fresh basis) at 9, 18 and 29% in dKC-25, dKC-50 and dKC-75, respectively.

The lambs were offered the respective concentrate mixtures daily between 9:00 and 9:30 h, to meet protein requirements (ICAR, 1998) for maintenance and expected daily gains of 75 g. The lambs were fed concentrate mixture around 1.6–1.7 percent of bodyweight. The remaining requirements were met through feeding of chaffed finger millet (*Eleusince corocana*) straw (~1.6% of body weight), which was offered after 2:00 h of feeding concentrate mixture fed to ensure its maximum consumption. On an average lambs consumed around 250–350 g each of concentrate and ragi straw across different treatment groups. All lambs were weighed individually at weekly intervals to assess body weight changes and growth

Table 1
Ingredients and chemical composition of feeds used in the experiments.

Item	dKC 0	dKC 25	dKC 50	dKC 75	Ragistraw
Ingredients (%)					
Maize grain	31	31	33	34	
Soybean meal	30	22.5	15	7.5	
Karanja detoxified cake	0	9	18	29	
Wheat bran	36	34.5	31	26.5	
Mineral mixture[A]	2	2	2	2	
Salt	1	1	1	1	
Dry matter (%)	96.84	97.26	97.51	97.01	93.53
Organic matter (% DM)	91.70	92.13	93.28	93.69	91.58
Ether extract (% DM)	2.61	3.00	3.73	3.35	1.18
Crude protein (% DM)	22.75	22.57	22.30	21.72	4.05
Acid detergent fibre (% DM)	8.89	8.63	9.05	8.57	43.35
Karanjin (%)[a]	–	0.0027	0.0054	0.0087	–
Trypsin inhibitor activity (μg/g)[a]	–	35.1	70.2	113.1	–

dKC-0, detoxified karanja cake 0% replacement with Soybean cake; dKC-50, detoxified karanja cake 50% replacement with Soybean cake and dKC-75, detoxified karanja cake 75% replacement with Soybean cake.

[A] Commercial mineral mixture with the composition per kg: Cobalt-150 mg, copper-1200 mg, iodine-325 mg, iron-5000 mg, magnesium-6000 mg, potassium-1500 mg, selenium-100 mg, sodium-10 mg, sulphur-5.9 mg, zinc-0.942%, DL Methinonine-9600 mg, L-lysine, mono hydrochloride-4400 mg, calcium-24%, phosphorous-12% was used.

[a] Calculated values on the basis of concentrations of detoxified karnaja cake.