



The effect of grain supplementation on alpaca (*Vicugna pacos*) production and meat quality



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ABSTRACT

The objective of this study was to determine the effects of grain supplementation on alpaca production and meat quality, from animals raised under a pasture based system in Australia. A total of 56 castrated male alpacas were randomly assigned to one of eight groups (n = 7 per group). The eight groups represented two nutritional treatments (pasture-only or pasture + grain supplementation), with each treatment having four replicates. Supplemented animals were incrementally introduced to the ration over a two week period and fed a total grain ration (calculated on 300 g/animal/day fed on a paddock basis to reflect commercial feeding) for 8 weeks prior to slaughter. The ration was comprised of whole oats, rolled barley, cracked lupins, cracked corn, black sunflower seeds plus an oil and mineral premix. There was a similar pasture base across all treatments. Supplemented animals displayed larger weight gains (0.64 kg/week) across the experiment in comparison to pasture-only animals (0.54 kg/week). Although not statistically significant, supplemented animals generated on average, larger eye muscle areas (26 cm² compared to 25 cm²) and higher percentages of intra muscular fat (IMF) in the *m. longissimus thoracis et lumborum* (0.76% compared to 0.67%). Supplementation had minimal effect on fatty acids profiles, including health claimable fatty acids and total omegas. This is likely due to the ration being fed to complement a pasture based system, which is typical for this industry, rather than if it was a substitution ration which would reflect a more intensive system. Overall, grain supplementation was found to increase alpaca production (growth rate) without compromising any of the health benefits associated with this red meat product. The evidence in this study suggests that increasing IMF content of alpaca meat, particularly in *m. biceps femoris*, will enhance health claimable fatty acid levels within alpaca meat. Greater differences between nutritional treatments would be expected during less favourable pasture conditions such as when pasture is limited due to unfavourable environmental conditions and below average rainfall leading to drought.

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1. Introduction

In Australia, alpacas are produced on predominantly pasture based systems which experience seasonal variation leading to variation in pasture biomass and quality throughout the year. This can impact on overall livestock performance, growth rates and productivity (Oddy and Allan, 2001; White, 2005) which in turn results in reduced carcass yield and increased variability in meat quality, especially from animals that are experiencing depleted glycogen reserves prior to slaughter (Ferguson et al., 2001).

Alpacas are currently being slaughtered all year round, although seasonal differences in feed availability can cause carcass and meat

quality variability. To prevent this, conventional livestock production systems commonly supplementary feed to finish stock prior to slaughter. Finishing diets and types of supplementation consist generally of high energy and protein feeds such as grain, forage crops, silage or hay which can be fed out to animals during time of limited nutrition (New Zealand Society of Animal Production, 2007). Producers are generally motivated to do this as any increase in costs associated with feeding is offset with an increased sale price.

Currently, there is no scientific literature available on how alpacas respond to supplementation and the impacts on carcass attributes and meat quality, particularly under Australian grazing conditions. Investigations of llamas in South America concluded supplementation with hay or grain improved carcass traits, with grain leading to benefits in growth rates and carcass traits (Mamani-Linares and Gallo, 2013). Although both alpacas and lla-

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mas are camelids they are quite different in their carcass and meat quality traits (Cristofanelli et al., 2004) and the effect of supplementation on alpacas under Australian conditions still needs to be determined.

In Australia, animals commonly remain within their paddocks, only being fed supplements when feed is limiting. Hence, research into the viability of grain supplementation, which is commercially available and easy to feed out, to increase animal growth and carcass weights without losing the health benefits of pasture fed meat would be beneficial (Nuernberg et al., 2005; Scollan et al., 2006; Daley et al., 2010). Supplementation may also be beneficial in achieving an earlier optimal slaughter weights in alpacas (Smith et al., 2015).

The nutritional quality of the pre slaughter diet can influence carcass and meat quality traits, especially in relation to fatty acid profiles, colour and sensory attributes (Scollan et al., 2006; Wood et al., 2008). These traits directly relate to consumer perception about meat quality and contribute to driving consumer satisfaction and repurchasing power.

The objective of this study was to determine if grain supplementation based on a pasture based system would improve alpaca production traits and to investigate the effects of grain supplementation on alpaca carcass and meat quality traits, from animals raised in an Australian pasture based system.

2. Methods

2.1. Experimental design and location

A total of 56 castrated male huacaya alpacas were inducted into a 12 week feeding period located at Berry, New South Wales, Australia (34°45'7.1316"S, 150°43'9.0186"W) during the Australian autumn. Animals were sourced from commercial meat herds and were on average 20.5 months (± 1 month) of age at the time of induction. The experimental design consisted of two nutritional on-farm treatments; pasture-only and pasture plus supplement (supplement), with each treatment having four replicates. Each replicate was randomly assigned a separate paddock ($n=8$) and seven animals were randomly assigned to one of the eight replicates. Two replicates from each treatment (total 4 groups) were inducted into the experiment at week 0 (24/02/2014), and the remaining animals were sent out to pasture for 14 days before being inducted into the experiment at week 2 (10/03/2014). This staggered effect was maintained across all feeding protocols and slaughter periods, resulting in two separate kill days (week 10 and 12) 14 days apart which was necessary due to logistical constraints at slaughter. This ensured the same feeding period (2 week ration adjustment and 8 weeks full ration pre slaughter) was achieved across all treatments and that both treatments were spread across both kill days. Animal ethics approval was granted by The University of Sydney Animal Ethics Committee (ethics number 2014/543, and protocol I.D543).

During the feeding period the average temperature ranged from 13.4–23.5°C (minimum 7.7°C and maximum of 26.3°C), an average solar exposure of 12.34 MJ m⁻² and with rain occurring non-consecutively on 25 days (average 4.15 ml/day, minimum 0 ml/day and maximum 193.4 ml/day) throughout the feeding period (Bureau of Meteorology, 2014).

2.2. Animal nutrition and management

2.2.1. Animal nutrition

The grazed pastures were improved with the predominant species being kikuyu (*Pennisetum clandestinum*) and an average replicate (paddock) size of 0.78 ha. Pasture biomass was recorded

Table 1

Nutritional comparison between formulated mixed grain supplementation (formulated) values versus as fed mixed grain supplementation (as fed) values.

Trait	Formulated values	As fed values
Crude protein (%)	18.8	20.3
Fat (%)	7.4	4.9
Acid detergent fibre (%)	^a	11.9
Neutral detergent fibre (%)	25.5	24.7
Ash (%)	6.7	7.2
Digestible dry matter (%)	67.4	77.6
Metabolisable energy (MJ/kgDM)	11.1	12.3

^a Formulated ADF value not available.

using a rising plate meter, and qualitative measures (including dry matter (DM), crude protein (CP), acid detergent fibre (ADF), neutral detergent fibre (NDF), digestible dry matter, metabolisable energy (ME), fat and ash) were recorded fortnightly (on average every 14 days ± 1 day due to logistics) from each paddock using methods outlined by Smith et al. (2015).

The required supplementation ration to meet animal requirements was calculated using Small Ruminant Nutrition Systems (SRNS) version 1.8.18 (Cannas et al., 2004). A modified sheep model was used and adjusted for species differences as there was no alpaca model available. The adjusted model was based on feeding a 20–22 month old (at the start of the feeding period) castrated male at approximately 40 kg live weight consuming 2% body weight in DM per day with the formulated nutritional values outlined in Table 1. The fed ration consisted of a commercially available mixed grain ration comprising 91% DM, 12.3 MJ/Kg DM of ME with additional nutritional values reported in Table 1.

The ration contained whole oats, rolled barley, cracked lupins, cracked corn, black sunflower seeds plus oil and mineral premix (Knowels Stockfeed and Trading Co, Moss Vale, Australia). Additional cracked lupins were added at 100 g/animal to increase protein levels to the required amount.

The supplementation ration was fed out on a daily basis into feed troughs with any refusals collected and weighed prior to the new ration being fed. To ensure the supplementation animals were trained onto the ration and did not suffer any adverse health effects, all supplemented animals were introduced to the ration over a two week period. This consisted of the ration being fed out at the rate of 50 g/animal/day for the first 5 days, 100 g/animal/day for the next 5 days, and 150 g/animal/day for the following 4 days before being fed a full ration of 300 g/animal/day (200 g grain mix + 100 g cracked lupins) for a total of 8 weeks prior to slaughter. This introductory feeding was applied to all replicate groups once they were inducted.

2.2.2. Pasture analysis

Pasture samples for biochemical and dry matter analysis were obtained across the experimental site with two quadrates (30 cm $\times$ 30 cm) samples being randomly taken from each replicate. All pasture within the quadrate was cut to approximately a 5 cm level (to simulate grazing) and placed into a pre-weighed empty bag and re-weighed to generate a fresh weight. Samples were placed into an oven (105°C) for 48 h then re-weighed and the DM calculated (fresh weight/dry weight $\times$ 100). Samples were pooled to represent each replicate per collection point and ground to 2 mm size using a hammer mill.

Protein was measured by placing 0.09 g ground sample into a prepared foil wrap and placing it into a Leco 428 analyser (Michigan, USA) which complies with AOAC methods 992.23, 992.15, 993.13 and AACC method 46-30 and converted into nitrogen (%) using a factor of 6.25 (McDonald et al., 2002).

For ADF and NDF determination, an 0.5 g ground and dried sample was weighed into specialised F57 fibre filter bags (ANKOM, New York, USA) before being sealed, stacked and analysed in an

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