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IMPROVING PRODUCTION OF MERINO SHEEP  
WITH PROTEIN MEAL SUPPLEMENTATION  
IN XINJIANG PROVINCE, CHINA

by

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## Declaration

*I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree.*

*I certify that, to the best of my knowledge, any help received in preparing this thesis and all sources used have been acknowledged in this thesis.*

A solid black rectangular box used to redact the author's signature.

Kai Dong Deng

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## Abstract

Sheep production in pastoral and agricultural areas in Xinjiang Province, China, is usually restricted by the low availability and poor quality of forages. Supplementation therefore plays an important role in improving animal performance in these areas, especially during winter. Feeding ruminants on roughages with protein meal supplements has been shown to improve growth rate, wool production, milk yield and reproductive performance of animals by improving total nutrient supply and/or balance of absorbed nutrients and thereby improving efficiency. Oilseed meals are abundant in Xinjiang Province, in particular sunflower meal (SFM) and cottonseed meal (CSM). In these two experiments, effects of supplementation with SFM or CSM on growth rate and wool production in Xinjiang Merino sheep fed mixed pasture hay were evaluated.

In the first experiment, effects of supplementation with SFM and CSM on live-weight gain and wool growth were examined at two planes of energy intake which represented the feeding conditions of maintenance and production respectively for sheep in Xinjiang Province. Twenty-four Xinjiang Merino ewe weaners (average initial liveweight 21.3 kg) were allocated to six treatments in a repeated randomised block design. Treatments were: 1) control (C), *ad libitum* access to mixed pasture hay with a daily supply of 10 g urea and 10 g mineral mix, 2) C + 120 g SFM; 3) C + 80 g CSM; 4) C + 200 g maize grain; 5) C + 200 g maize grain + 70 g SFM; 6) C + 200 g maize grain + 45 g CSM. Each supplemented sheep received 5 g supplemental N daily.

There were no significant interactions between protein source and maize supplement ( $P > 0.05$ ). Compared with C, SFM or CSM supplementation had no effect on hay dry matter intake (HDMI) ( $P > 0.05$ ) and maize feeding depressed HDMI by 15% ( $P < 0.05$ ). Clean wool production was increased by 29% ( $P < 0.05$ ) in sheep given SFM and live-weight gain was increased by 349% ( $P < 0.05$ ) in sheep given CSM. Fibre diameter was increased ( $P < 0.05$ ) by either SFM or CSM supplementation. Maize feeding increased ( $P < 0.05$ ) growth rate by 140% and increased ( $P < 0.05$ ) clean wool production by 50%, but did not affect fibre diameter ( $P > 0.05$ ). The apparent digestibility of dry matter (DMD) was increased ( $P < 0.05$ ) in sheep given SFM. The apparent N digestibility was increased ( $P < 0.05$ ) in sheep given either SFM or CSM, but N retention was only increased by CSM feeding ( $P < 0.05$ ). SFM or CSM supplementation increased ( $P < 0.05$ ) purine derivative excretion, suggesting an increase in microbial protein yield from the rumen. It was concluded that supplementation of sheep with CSM was probably a better option than supplementation with SFM for profitable production in sheep.

In the second experiment, responses in growth rate and wool production in sheep to different levels of CSM supplementation were examined, and the magnitude of responses was evaluated by comparing with a complete concentrate formulated as a standard diet. Twenty-four yearling Xinjiang Merino wethers (average initial liveweight 29.9 kg) were assigned, in a repeated

randomised block design, to six treatments, namely 1) mixed pasture hay offered *ad libitum* with a daily supply of 10 g urea and 10 g mineral mix (C); 2) C + 80 g CSM; 3) C + 160 g CSM; 4) C + 240 g CSM; 5) C + 320 g CSM; 6) C + 1,000 g well-balanced concentrate.

Compared with C, CSM supplementation depressed ( $P<0.05$ ) hay DM intake, increased ( $P<0.05$ ) average daily gain and clean wool production, but had no effect on fibre diameter ( $P>0.05$ ). The apparent digestibility of DM and N, plasma urea-N concentration, N retention and purine derivative excretion were increased ( $P<0.05$ ) by CSM supplementation. Live-weight gains in sheep receiving 80, 160, 240 and 320 g CSM/d were equivalent respectively to 13, 35, 45 and 53% of gain in sheep given the concentrate, whereas clean wool production accounted for 66, 72, 82 and 79% of the production in similar sheep given a well-balanced concentrate. It is suggested that supplementation with 160 g CSM/d was the best of the options investigated, because this treatment increased live-weight gain and wool production without affecting hay intake and fibre diameter.

Supplementation with CSM enhanced live-weight gain and wool production in sheep. However, the estimated efficiency of utilisation of rumen-degraded protein for microbial protein synthesis was relatively low. It seemed that a further increase in growth rate of animals with a high intake of supplemental protein might be expected by increasing energy supply. It was recommended that further supplementation with energy should be evaluated when oilseed meals and urea were offered to sheep fed low quality forages.