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Probiotic *Bacillus amyloliquefaciens* Strain H57 Improves the Performance of Pregnant and Lactating Ewes Fed a Diet Based on Palm Kernel Meal

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Probiotic supplements are single or mixed strain cultures of live microorganisms that benefit the host by improving the properties of the indigenous microflora (Seo *et al* 2010). In a pilot study at the University of Queensland, Norton *et al* (2008) found that *Bacillus amyloliquefaciens* Strain H57 (H57), primarily investigated as an inoculum to make high-quality hay, improved feed intake and nitrogen utilisation over several weeks in pregnant ewes. The purpose of the following study was to further challenge the potential of H57 - to show it survives the steam-pelleting process, and that it improves the performance of ewes fed pellets based on an agro-industrial by-product with a reputation for poor palatability, palm kernel meal (PKM), (McNeill 2013).

Thirty-two first-parity White Dorper ewes (day 37 of pregnancy, mean liveweight = 47.3 kg, mean age = 15 months) were inducted into individual pens in the animal house at the University of Queensland, Gatton. They were adjusted onto PKM-based pellets (g/kg drymatter (DM): PKM, 408; sorghum, 430; chick pea hulls, 103; minerals and vitamins; Crude protein, 128; ME: 11.1MJ/kg DM) until day 89 of pregnancy and thereafter fed a predominately pelleted diet incorporating with or without H57 spores (10^9 colony forming units (cfu)/kg pellet, as fed), plus 100g/ewe/day oaten chaff, until day 7 of lactation. From day 7 to 20 of lactation the pelleted component of the diet was steadily reduced to be replaced by a 50:50 mix of lucerne: oaten chaff, fed *ad libitum*, plus 100g/ewe/day of ground sorghum grain with or without H57 (10^9 cfu/ewe/day). The period of adjustment in pregnancy (day 37-89) extended beyond expectations due to some evidence of mild ruminal acidosis after some initially high intakes that were followed by low intakes. During that time the diet was modified, in an attempt to improve palatability, by the addition of oaten chaff and the removal of an acidifying agent (NH_4Cl) that was added initially to reduce the risk of urinary calculi. Eight ewes were removed due to inappetence, leaving 24 ewes to start the trial at day 90 of pregnancy. From day 90 of pregnancy until day 63 of lactation, liveweights of the ewes and their lambs were determined weekly and at parturition. Feed intakes of the ewes were determined weekly. Once lambing began, 1 ewe was removed as it gave birth to twin lambs (whereas the rest gave birth to a single lamb), 4 due to the loss of their lambs (2 to dystocia), and 1 due to copper toxicity. The PKM pellets were suspected to be the cause of the copper toxicity and so were removed in early lactation. Hence, the final statistical analysis using STATISTICA 8 (Repeated measures ANOVA for feed intake, One-way ANOVA for liveweight change and birth weight) was completed on 23 ewes for the pregnancy period ($n = 11$ fed H57; $n = 12$ control), and 18 ewes or lambs for the lactation period ($n = 8$ fed H57; $n = 10$ control).

From day 90 of pregnancy until parturition the H57 supplemented ewes ate 17% more DM (g/day: 1041 vs 889, sed = 42.4, $P = 0.04$) and gained more liveweight (g/day: 193 vs 24.0, sed = 25.4, $P = 0.0002$), but produced lambs with a similar birthweight (kg: 4.18 vs 3.99, sed = 0.19, $P = 0.54$). Over the 63 days of lactation the H57 ewes ate similar amounts of DM but grew slower than the control ewes (g/day: 1.5 vs 97.0, sed = 21.7, $P = 0.012$). The lambs of the H57 ewes grew faster than those of the control ewes for the first 21 days of lactation (g/day: 356 vs 265, sed = 16.5, $P = 0.006$). These data support the findings of Norton *et al* (2008) and Kritas *et al* (2006) that certain *Bacillus spp.* supplements can improve the performance of pregnant and lactating ewes. In the current study we particularly highlighted the capacity of H57 to stimulate immature ewes to continue to grow maternal tissue through pregnancy, possibly through an enhanced appetite, which appeared then to stimulate a greater capacity to partition nutrients to their lambs through milk, at least for the first few weeks of lactation, a critical time for optimising lamb survival. To conclude, H57 can survive the steam pelleting process to improve feed intake and maternal liveweight gain in late pregnancy, and performance in early lactation, of first-parity ewes fed a diet based on PKM.

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