

Supplementary feeding of grazing sheep in South Africa - shortcomings and solutions

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The challenge remains to supplement sheep with adequate protein, bypass protein, energy and micro-nutrients to complement the supply of these nutrients by the grazing in such a way that they receive optimal nutrients which enable them to perform to their full genetic potential.

The declining profitability of sheep farming will force producers to dramatically increase the biological efficiency and productivity of their sheep enterprise (Lynch, 2012), and therefore precision sheep farming is needed to take sheep farming to the next level. The profit drivers in woolled sheep farming are the kilogram of lamb and wool produced per ewe or more correctly, per hectare per year. The current recommended target is 0.75 to 1 kg lamb marketed or retained as replacement per kilogram ewe mated per year (Vipond et al., 2009; Farquharson, 2011). It is possible to reach these targets with Precision Feeding. The focus is to produce more lambs that will grow at a higher rate and to market them earlier with strategic supplementary feeding. The aim of this article is not to write a comprehensive review regarding supplementary feeding that increases production (i.e. growth, wool production & reproduction), but to highlight a few of the most important supplementary feeding success stories in South Africa.

Urea based multi-nutrient supplements

The major feed sources of grazing sheep are natural veld and shrubs, cultivated pastures and crop residues which are all high in fibre. The major limitations associated with the utilization of pastures and fibrous residues as feedstuff for sheep are the low intake and digestibility thereof as well as nutrient imbalance. The primary limitation to feed intake seems to be nutrient imbalance. Increases in voluntary feed intake and efficiency of utilization have been reported with the supplementation of protein, sulphur, sodium, calcium, phosphorous, cobalt and selenium. These nutrients are supplemented via urea-based multi-nutrient supplements.

The use of urea-based multi-nutrient supplements (licks or blocks) resulted in vast improvement of performance of sheep grazing dry natural veld and dry crop residues in South Africa. However, from results obtained with the supplementation of urea based multi-nutrient licks as well as latest research it is clear that it does not unlock the full genetic potential of highly productive animals (late pregnant ewes expecting multiples; ewes rearing multiples; young fast growing lambs, etc.). In this regard it seems that supplementation of both bypass protein and bypass energy are also necessary. If there is abundant dry feed the supplementation of urea or non-protein (NPN) based licks (providing urea, sulphur and trace minerals) is the minimum input, but better responses are achieved with bypass protein meals (e.g. fishmeal cotton oilcake meal, soybean meal, etc.), whereas supplementation of both gives vastly superior results to either source of nutrients alone (Leng,



1988) (please refer to the Section on Bypass Protein). Symptoms of bypass protein include birth problems (dystocia), abnormal thick and viscous colostrum as well as low milk production resulting in high lamb mortalities and lower lamb growth rate.

Trace mineral supplementation

According to McDowell (2003), optimum mineral allowances are needed to permit animals to achieve their full genetic potential for optimum performance. Small stock cannot perform to their full genetic potential if their micro-nutrient needs are not met, even if they receive 100 % of their protein & energy needs (Kinser, 2001). Trace element supplementation via free-choice licks remains one of the cheapest options but disadvantages are the unregulated intake thereof; large variability in intakes; inadequate intake and presence of antagonists which render some trace elements biologically unavailable (Reeve, 1996). Therefore, Arthington (2002) is of the opinion that in most grazing situations, trace mineral-containing salt blocks cannot provide sufficient trace mineral intake to meet nutritional needs. Chelation, the process of bonding trace minerals to organic compounds, is one method to overcome the problem of antagonism to provide trace elements in a form which is more bio-available to the animal. Partly (20 – 30 %) replacing the inorganic trace elements in licks with organic (e.g. chelated) trace minerals is practiced by leading Feed companies in South Africa, but it still does not solve the problem with large variation in lick intake.

This led to the development of an injectable trace mineral supplement, Multimin, which is a balanced, complementary trace mineral supplement supplying critical trace elements such as zinc, copper, manganese and selenium in a tissue compatible and highly biologically available form (EDTA chelation). Multimin is indicated for use four weeks before critical events

(mating, lambing and weaning) to correct possible trace mineral imbalances and also to enhance trace element functions at these critical events when needed most. Supplementing injectable vitamin A + E with Multimin will further enhance the synergistic effects of zinc x vitamin A and selenium x vitamin E.

A scientific specially formulated “multi-nutrient liquid booster drench,” Byboost Nutraceutical range, was recently developed to improve growth, fertility and immunity and thus to maximize animal performance. This product supplies up to 23 nutrients including vitamins and chelated trace elements.

Due to the shortcomings of trace element supplementation via free-choice licks additional trace element supplementation (Multimin or Byboost) at critical stages in the livestock production and reproduction cycle is becoming a favoured method to guarantee trace element status of small stock in conjunction with licks. This additional trace element supplementation serves as a top-up to ensure optimal reproduction efficiency and immunity. It is specifically targeted during periods of stress and high demand (i.e. four weeks pre-mating, four weeks pre-lambing, at weaning, at introduction to grass- or feedlotting, etc.) when there is also a high probability that a response will be obtained. Nowadays, most nutritionists recommend sheep producers to continue with a solid traditional trace element lick supplementation programme (two-thirds inorganic and one-third organic trace elements) alongside with an additional trace mineral supplementation (Multimin or Byboost).

Grain supplementation

Sheep producers often use cereal grains (i.e. barley, triticale, wheat, oats and maize) as a supplement on dry grazing. According to Leng (1988), cereal grain supplement on dry grazing

is usually a waste of money because there is primarily not an energy deficiency, but a protein deficiency. Cereal grains, with a high starch content, are used extremely inefficiently during the first six weeks of feeding. The low fibre and high starch content (> 50 %) of cereal grains can cause grain poisoning (acidosis) if animals are introduced to large amounts of these grains quickly. Cereal grain supplementation can also reduce pasture intake (substitution) and depress the digestion of roughage. The adverse effects of cereal grain supplementation can be minimized or eliminated by mixing the cereal grain with fermentable or readily-degradable protein sources (e.g. lupins, soybeans, sunflower oilcake meal, etc.), as suggested by Murray (1993) to increase the protein content, minimize the starch content and to supply essential nutrients to the microbes in the rumen. Where lambs received a medium quality roughage *ad lib.* the strategy increased roughage intake and enhanced animal performance by increasing liveweight gain, carcass weight, wool growth rate and altering fat depth. This research indicated that if there is a demand for larger and leaner carcasses the best option probably would be to replace the cereal grain supplement with bypass protein meal and when larger and fatter animals are required replacing cereal grain partly or totally with lupins, depending on the price of lupins (Coetzee *et al.*, 1995b). A shortcoming of this strategy is that it lacks in minerals and trace minerals as well as bypass protein for highly productive animals.

An EC Feed-based concentrate was originally developed in South Africa containing urea, ammonium salts; minerals; trace minerals; vitamins; an ionophore and buffers to enrich cereal grain, to control rumen pH and lactic acid production. This concentrate was named chocolate concentrate due to the brownish colour of the final grain mixture. The concentrate has the unique characteristic that it sticks to the grain and therefore can be fed on the ground. Several commercial products developed from this original concept. This chocolate grain was widely used as a supplement for grazing sheep and to finish sheep on the veld (veldlotting) and in a feedlot. A shortcoming of chocolate grain was that it lacked in bypass protein for highly productive animals. The inclusion of bypass protein was not always successful because the bypass meal particles do not effectively stick to the grain (please refer to the Section on Bypass Protein). Often sheep producers use cereal grain screenings in stead of cereal grains because screenings are a much cheaper option. These screenings often contain weed seeds which then germinated and grow in the areas where this is fed to sheep. This is a huge problem, especially when fed on stubble lands allocated for cereal crop production. This problem is solved by treating screenings beforehand with caustic soda (so-called caustic treated grain or sodagrain) in mixer wagons. Caustic soda is a hazardous chemical thus the necessary safety precautions should be followed. With a pH of 11 and higher treated grain is very alkaline and thus a very good buffer.

Grazing crop residues of maize and small grain or unharvested grain (e.g. “weimielies”) often causes huge problems (e.g. laminitis, acidosis, bladder stones, etc.) and even high mortalities due to the ingesting of too much grain. These problems were mainly solved with the development of a Buffer Lick containing an ionophore and buffers. Even with good management incidents of acidosis still occurred. Micro-organisms (*Streptococcus bovis* and *Lactobacilli*) convert the starch in grain to undesirable lactic acid which leads to rumen acidosis, low feed intake, diarrhoea, bloat and laminitis. The end result is lowered and inefficient growth, health problems and in severe cases death of the animal. The *Megasphaera elsdenii* is the most important lactate-utilising



micro-organism in the rumen of sheep. This organism plays an important role in preventing build-up of lactic acid in the rumen during adaptation from low to high concentrate diets. Recently, a product, LacticonS (V22206) was developed and registered containing a naturally selected strain of *Megasphaera elsdenii*, NCIMB 41125, an unique rumen specific micro-organism for easier adaptation on high starch containing grazing and diets. As a potent aid in the prevention of ruminal acidosis sheep are dosed with LacticonS just before commencement of grazing crop residues or unharvested maize or entering a feedlot.

Bypass protein supplementation

Grazing sheep are relying on rumen microbial protein (MP) supply to the small intestine to deliver sufficient amino acids. Optimal microbial protein synthesis occurred when the available energy is balanced with nitrogen from urea-based licks and degradable protein sources. However, microbial protein only supports normal, but not maximal growth and milk production (Virtanen, 1966; Storm & Ørskov, 1984) and therefore cannot unlock the full genetic potential of sheep.

Dr. Coetzee did pioneering work when he introduced the concept of bypass protein on a large scale in practice in South Africa. Bypass protein supplementation resulted in a revolutionary turnaround in the sheep industry in South Africa increasing both weaning percentage and lamb growth rate and thus the profitability of sheep farming. In most experiments, especially with highly productive animals, bypass protein has proven superior to urea-based licks and readily-degradable protein sources. Therefore, bypass protein is a critical nutrient to unlock the full genetic potential of sheep. Supplementation of a high

level of bypass protein reduces lamb mortality and increases lamb growth rate because it:

- Promotes udder development;
- Promotes the production of colostrum with low viscosity (not viscous);
- Increases colostrum and milk production;
- Improves mothering ability of ewes and vitality of lambs;
- Limits birth problems (yellowish lambs at birth);
- Ensures ideal birth weight (4.5 to 5.9 kg) that will result in maximum lamb survival.

Numerous bypass protein-based commercial licks are available in a meal, block or pellet format providing urea, fermentable protein, bypass protein, macro minerals and trace minerals. However, bypass protein meals (e.g. fishmeal, cotton oilcake meal, soya bean meal, etc.) can be directly supplemented to sheep. The suggested daily levels of bypass protein meal are at least 50 to 150 g for weaned lambs; 0 to 50 g for the first 100 days of pregnancy; 100 to 150 g for late pregnant (100 days onwards) and lactating ewes plus a free choice urea-based multi-nutrient lick on dry pastures (Leng, 1988). According to Vipond *et al.* (2009) we continue to get basic feeding wrong by underfeeding bypass protein in late pregnancy. In his research, ewes received daily 100 g of a bypass protein source per fetus in late gestation and 200 g per lamb suckling in early lactation. The bottomline is that ewes must milk like dairy cows if lambs are to grow at an optimal rate (Farquharson, 1999) to unlock their full genetic growth potential.

Response with flush feeds in terms of lambing percentage are mostly variable (-17 % to +15 %) and not much predictable (Van Pletzen, 1990). This is in comparison with the -14 % to +21 % responses in lambing percentage as reported by Croker *et al.* (1985). Trials done revealed that there are “specific nutrients”

that stimulate ovulation rate in breeding ewes (Coetzee, 2005 — unpublished data). Highly fertile ewes (i.e. ewes producing multiples the previous lambing season) give excellent response to the supplementation of “specific nutrients.” Lambing percentage of ewes, which lambed twins the previous lambing season, increased with 20 to 33 percentage units when flushed with these “specific nutrients” (Coetzee, 2005; 2009). According to Martin (2005), flush feeding will increase ovulation rate of ewes if they have a high genetic ovulation potential. Research by Demmers *et al.* (2011) confirms that highly fertile ewes (e.g. ewes which regularly give birth to multiples) give a much greater response to flush feeding (up to 27 – 45 % higher ovulation rate) than ewes born from lower fertile mother lines (i.e. ewes that lamb singles or skip regularly). It is therefore economically justifiable and non-negotiable to provide flush feed to ewes that had twins in their previous lambing season, even if they are in an excellent condition. The remainder of the ewes are given flush feeding only if they are lean or thin (< 3.0 CS), but not if they are in an excellent condition (> 3.5 CS) as it is then not economically justifiable.

Creep feeding is a management tool that can be used to make sheep farming more profitable (Roux, 2011). Due to the high essential amino acid requirements of young growing lambs, creep feed should contain a very high level of excellent quality bypass protein with the correct amino acid profile to fully unlock the genetic growth potential of lambs. Finisher pellets; Ram, Lamb and Ewe pellets, etc. should not be used as a creep feed, because due to their lower bypass protein content they are unable to unlock the full genetic growth potential of suckling lambs. To ensure excellent response with creep feeding a high quality creep feed (> 18 % protein) should be provided whereas provision for enough creep feeding space (minimum 5 cm/lamb) is crucial to obtain a good response. Due to the excellent ability of young suckling lambs to convert feed to muscle growth the current payback in South Africa (i.e. benefit cost ratio) is ± R2 to R3 per Rand spent on creep feed.

The target goal when finishing weaned lambs on good quality green veld or cultivated pastures is to minimize the grazing days of lambs by maximizing their growth rate and improving their feed conversion ratio by the supplementation of a Pasture Finisher supplement (± 1.5 % of body weight) with a very high level of bypass protein. With a high bypass protein intake, most of the weight gain or the growth of the lamb is in the form of muscle growth and it helps to fully unlock the genetic growth potential of lambs. Fraser *et al.* (1991) clearly demonstrated that the growth of lambs that grazed even high quality grass or legume pastures and grow at more than 200 g/day can further be increased with 93 % (201 vs. 388 g/day) by the supplementation of a high level of bypass protein. According to Geoff Robards (2000) increasing the bypass protein intake is the most important way to increase the productivity of animals such as growing lambs as these animals have a genetic ability (capacity) for production in excess of their ability to absorb nutrients even on the highest quality grass-legume pastures. A special Pasture Finisher supplement with a high bypass protein content which we developed substantially increases growth rate; improves feed conversion and increases dressing percentages with up to 2 – 4 % (Brand *et al.*, 1999; Coetzee, 2000). Due to the fact that these lambs are ready for slaughter sooner, up to 57 days and more, substantial amount of pastures can be saved.

Future of supplementation feeding

Buying all purpose licks and diets off the shelf (co-op floor) the “one feed or supplement does all” approach is just not correct. In future we will see more and more licks and diets specifically formulated for a farm (customised nutrition) or even more specific for animals in a specific physiological stage. Demand for ready-mixed licks in pellet and block format will also increase in future due to problems with labour, baboons, monkeys and birds.

There is also an urgent need for a sophisticated whole-farm analytical simulation and optimization model such as the Australian Midas computer program. This program takes all factors into account such as rainfall, temperature, soil type, pasture types, sheep types, optimum combination of animal types, cash crops, production systems to determine the most profitable system for a specific farm.

In future more and more computer models [e.g. Mechanistic model (CNCPS-S)] for predicting the nutrient requirements for sheep (Cannas *et al.*, 2004) will be used. This is because the current NRC (2007) nutrient requirements tables, which are used, are an improvement on the previous tables (NRC, 1985), but still tender only for optimal/normal conditions and for animals within the midrange of a population. It prevents clinical deficiency under normal conditions, but the incidence of metabolic disorders which still occur under practical farming conditions is an indication that nutrient intake does not satisfy the requirement of animals in all cases nor is it able to unlock the full genetic production and reproduction potential of sheep.

Levels of essential amino acids supplied to the small intestine are of critical importance for maximum performance in ruminants (Sloan, 1997) and therefore to unlock their full genetic potential of sheep. To optimize production of meat, milk, conceptus and wool protein, certain amino acids may limit the attainment of optimal production levels. Under above-mentioned conditions bypass protein with correct amino acid profile or rumen-protected limiting amino acids should be fed to complement the supply of

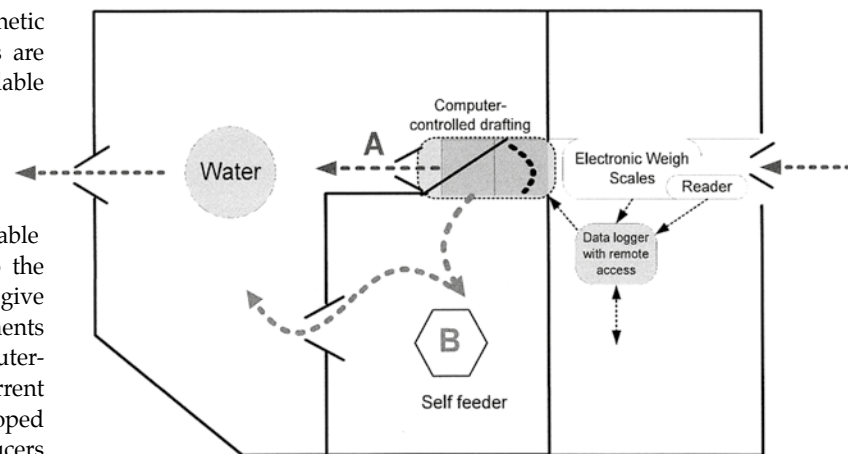


amino acids from microbial protein (MP) to unlock the full genetic potential of small stock. Therefore in future, nutritionists are going to formulate licks and rations more and more on available amino acids and not merely on bypass protein requirement.

The recommendations put forward in this paper aim at maximizing the efficiency of supplementary feeding strategies for grazing sheep by balancing the nutrients available to the animal for productive purposes. However, due to the complexity of factors involved it still remains very hard to give precise recommendations on when and what supplements should be fed. Therefore, there is an urgent need for a computer-based nutritional management program, similar to the current GrazFeed program. The GrazFeed program has been developed by the CSIRO in Australia as a practical tool to assist producers to make informed decisions on the choice, level and duration of supplementation to be adopted. GrazFeed is a decision support tool to help graziers improve the profitability of their livestock production, through more efficient use of pastures and supplementary feeds. GrazFeed is regarded as the industry benchmark for the nutrition of grazing animals in temperate Australia. This program helps users to decide what level of annual production a particular pasture will support; to minimize the cost of supplementary feeding; to select the most suitable feeds (supplements) and to use only the amount required to maintain stock or achieve a production target.

Components of a proposed precision nutrition system that will form an integral part to tailor made precision feeding of sheep in future (Jordan *et al.*, 2006) are given in the diagram below. Precision feeding is to feed the right supplement of the right quality (Blache & Martin, 2010) at the right level (quantity) at the right time or stage for the right period to ensure optimum response and to maximize profit. The aim in future is to feed individual animals and not the whole flock. Sheep will be fitted with electronic eartags and fed according to each one's specific need. A small pen will be set up in a grazing camp that sheep will have to enter to drink water and to get their allowed (permitted) amount of supplement. Each time they enter the pen they will be automatically weighed and they can also be drafted automatically in different groups if needed.

Precision Nutrition System Set Up In The Grazing Camp



Conclusion

Effective supplementary feeding practices form an integral part of effective management and breeding practices. These practices must not be seen in isolation, but as a unit – together they form the basis of a profitable sheep enterprise. Superior genetics need to go hand-in-hand with effective nutrition and management (Ingham, 2005) to unlock the full genetic potential of small stock. Optimum production and maximum profitability is achieved through a combination of improved genetic potential, application of key management practices and intake of balanced nutrients (Larsen, 2007).

Producers will find it difficult to increase income over costs without using new technology and management methods (Willemse, 2001). According to Lynch and Hanrahan (2011), the top 25 % farms in their investigation produced 35 % more kg lamb carcass/ha than the average of all farms by using modern technology and the latest farming practices. In this regard, Australian consultants agree that the willingness of producers to apply new technology and management practices in their flocks largely determine their profitability. Wealth does not lie in the number of ewes only, but also in the use of new technology.

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