THE POTENTIAL FOR GOAT PRODUCTION

J.C. THROCKMORTON*

SUMMARY

This paper reviews recent research in goat nutrition and production. The characteristics that may favor goats over other livestock are discussed, and an attempt is made to evaluate whether these same characteristics constitute a benefit or hazard to the environment.

INTRODUCTION

Goats have a potential to efficiently produce the whole spectrum of animal products. For instance, the efficiency of converting digestible organic matter into milk is up to 28% greater in dairy goats compared to cows in similar environments (Devendra, 1975). Another example is fiber production where Angora goats have been shown to be three times more efficient at converting digestible energy to fiber compared to Rambouillet sheep (Gallagher and Shelton, 1932).

Potential should, reflect those characteristics in which goats excel over, or are complementary to, other ruminants in the same system. The main areas are improved roughage digestion; tolerance to water deprivation, preference for browse or plant species not selected by other livestock, and efficiency of production of milk, fiber (mohair), and low-fat meat. Two other factors that have a major impact on goat potential are their small size and religious amnesty in terms of lack of taboos against goat meat.

AREAS OF POTENTIAL

Roughage digestion

The fibrous fraction of plants are digested to a greater extent by goats compared to sheep in many situations, and as the roughage component increases the difference becomes more pronounced (El-Hag 1976; Wilson 1977; Doyle and Egan 1980; Gihad 1980). A good example of this is the comparison between sheep and goats of their utilisation of untreated and alkali-treated rice straw in Egypt (Gihad 1980). Goats consumed more rice straw regardless of treatment and digested all components of untreated straw (except acid-detergent lignin) to a greater extent than sheep. When treated straw was fed there was only a slight improvement in digestibility in favour of goats. Studies with hays from tropical grass showed similar results favouring goats over sheep for intake and fiber digestion (Gihad 1976) (Table 1). Doyle and Egan (1980) compared digestion in Angoraz and Merinos of temperate grass-clover hays and found that as forage quality decreased, the difference in favor of organic matter and cell wall digestion by goats increased. The goats also showed a 19-30% increase in rumen retention time of particles (103-Ruphen). This may be a partial explanation for increased fiber digestion. Other reasons may be increased salivary secretion in goats compared to sheep (Seth et al. 1976) during resting and feeding.

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and/or a longer rumination cycle (Geoffrey 1974). Available results on digestion in goats suggest that their potential may be centered around feedstuffs high in fiber.

**TABLE 1** Per cent of crude fiber digestion in goats and sheep

<table>
<thead>
<tr>
<th>Feedstuff</th>
<th>Goats</th>
<th>Sheep</th>
</tr>
</thead>
<tbody>
<tr>
<td>* African hay</td>
<td>60.3</td>
<td>56.5</td>
</tr>
<tr>
<td>** Rice straw</td>
<td>63.3</td>
<td>53.1</td>
</tr>
<tr>
<td>** Alkali-treated rice straw</td>
<td>78.4</td>
<td>75.1</td>
</tr>
<tr>
<td>*** Tree leaves</td>
<td>20.7</td>
<td>14.2</td>
</tr>
</tbody>
</table>

*Gihad 1976; **Gihad 1980; ***Wilson 1977

Browse refers to leaves and stems of trees and shrubs. The preference for browse by goats is well documented (McMahon 1964; Wilson 1975; Batten 1979) (Table 2). This type of vegetation often contains high levels of fiber and ash in combination with moderate levels of protein. The structural relationship between components in browse can play a major role in its nutritive quality. For example, extensive areas of Texas are occupied by live oak (Quercus virginiana) browse which is selected by goats in contrast to sheep or cattle. Huston and Shelton (1967) observed in Angoras that addition of 15% ground oak leaves to an oats-cottonseed meal based diet resulted in an apparent decrease in crude protein digestibility of 4.4%, but a 34.7% increase in nitrogen retention, primarily due to a 13% reduction in urinary nitrogen. In a second experiment; all goats were offered free choice a ground basal diet consisting of one third of each: sorghum hay, lucerne hay and sorghum grain. When one group was offered fresh live oak browse, the small amount consumed (unknown) caused a 7% reduction in basal intake, a 21% reduction in weight gain, but a 29% increase in weight yield of mohair. These results may be related to the tannin content of oak and/or the high mineral content (47% ash) which could alter ruminal degradation of nutrients in the oak and/or the basal diet, allowing them to bypass the rumen. The selection of browse by goats may contain more productive potential than would be expected by simple chemical analysis.

**TABLE 2** Composition of diets selected by goats and sheep

<table>
<thead>
<tr>
<th>Stocking rate</th>
<th>Trees and Shrubs (%)</th>
<th>Stocking rate</th>
<th>Herbaceous plants (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Goats</td>
<td>Sheep</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>78</td>
<td>19</td>
<td>Low</td>
</tr>
<tr>
<td>Medium</td>
<td>71</td>
<td>35</td>
<td>Medium</td>
</tr>
<tr>
<td>High</td>
<td>85</td>
<td>90</td>
<td>High</td>
</tr>
</tbody>
</table>

*Wilson et al 1975

Browsing preference by goats may also allow them to synergistically coexist with other livestock species, increasing both animal products/ha and feed output/ha by retarding encroachment of browse species on
Long term studies in Texas (Merrill et al. 1966) showed that after 16 years (including 7 years of drought) the best gross returns and best range condition were obtained when goats and cattle or goats, cattle and sheep were stocked together. Gross returns and range condition were poorest for cattle alone and sheep alone respectively.

**Weed control**

Dietary preferences of goats also make them useful as a method of biological weed-control. Observations by Kajons and Holst (1977) and Campbell *et al.* (1979) have indicated that goats can potentially control several weed species in Australia through prevention of flowering, preferential grazing pressure and mechanical damage. Brush control studies in New Zealand (Batten 1979) showed that goats placed in sheep and cattle pastures markedly reduced the growth of several scrub weeds but did not affect the growth of others. Similar observations were made in shrub communities, of Australia (Wilson 1975) where feral goats removed all available foliage from certain trees and shrubs but refused to consume other species. The conclusion was made that goats did not provide a solution to weed control in this environment. Overall, these studies indicate that there is potential for exploiting the browsing habits of goats, but preference for available vegetation must be known before it can be determined whether goats will be a benefit or detriment to the pastoral environment.

**Water requirements**

One of the major constraints in many ecosystems is water. Some goats have been shown to be particularly adapted to these areas due to their ability to conserve body water and still remain productive. In *Israel*, Black Bedouin goats are found grazing two days away from water and still producing two litres of milk/day. Maltz and Shkolnik (1980) studied lactation during water deprivation (30°C and 30% relative humidity) and found that does lost weight but milk yield remained unaffected until after 48 hr. After 96 hr. without water, the goats had lost over 30% of their body weight but had not markedly reduced feed intake. Daily water loss in milk exceeded total loss in urine and faeces and approached evaporative water loss. When does were given access to water, they immediately consumed enough water to compensate for any loss and resumed full milk production. Shkolnik (1980) also studied water retention time in the forestomach and found that 81% of consumed water still remained in the *rumen* after 5 h, suggesting that *rumen* development in Black goats has favoured its use as a water reservoir. This example illustrates the potential of goats to thrive in arid environments and may partially explain why over two-thirds of the world's goats are located within 30° of the equator, with most of them concentrated in the arid zones. As with dietary preference, tolerance to water deprivation can make the existence of goats in certain environments a benefit or a problem. Although their physiology may allow them to exploit areas where other livestock cannot survive, the same traits may allow goats to rapidly destroy delicate ecosystems such as is found in deserts. Available evidence suggests that proper utilization of goat potential may require a higher degree of management than other species of livestock.
Meat production

The three main products of goats are meat, milk and fiber. Skins are a minor product but often yield very high quality leather. In terms of world markets, meat production predominates, but in each production category goats show considerable potential.

The major potential of meat goats is related to their high fecundity and fertility (150% kid crop is usual), low-fat carcass composition and lack of religious taboos against goat meat. Depending on the location, the reproductive rate of goats may be a boon or a burden. In less developed countries where 79% of the goat population exists (FAO 1976), a short generation interval and a high percentage of twins and triplets suggests a rapid turnover rate where animal protein is very much in need. Reports of a 22% improvement in weaning weight when Anglo-Nubians were crossed on native Caribbean goats (Wilson et al. 1980) lends more promise to this aspect. In Australia however, the fecundity of the feral goat has been a detriment since it has allowed it to attain high populations rapidly and exert additional grazing pressure on rangelands that have already been historically abused. The current trend in developed countries towards lean meat favors the goat. Owen et al. (1978) made the best definitive comparison of native South African Sheep and goat carcasses and showed that goats had approximately 16% more lean and 40% less dissectable fat than similar-aged sheep. (Table 3) The fat in goat meat also tended to be more concentrated internally rather than externally. The majority of Australian goat meat has traditionally been exported to Asia and other countries (Holst and Whitelaw 1980). However, recent newspaper reports (Anonymous 1981) indicate that there is a substantial demand for young goat meat in Sydney and Brisbane. Unsatisfied demand for Australian goat meat may suggest taking a closer look at management of the Australian goat population for meat production.

<table>
<thead>
<tr>
<th>TABLE 3* Carcass composition of native goats and sheep</th>
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<tbody>
<tr>
<td>Components (%)</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Lean</td>
</tr>
<tr>
<td>Dissectable fat</td>
</tr>
<tr>
<td>Bone</td>
</tr>
</tbody>
</table>

*M Owen et al 1978

Milk production

Milk production potential in goats focuses on two aspects; their high efficiency of conversion of digestible organic matter to milk, and their increased milk yield/unit liveweight. Devendra (1975) summarized studies in both temperate and tropical environments and found dairy goats to be 8-28% more efficient than cows in similar conditions. The main reason for this appears to be related to the smaller size of goats compared to cows. As size decreases metabolic rate increases, which causes a higher dry matter intake. Intake is often a primary constraint to maximum milk yield. It is not unusual for lactating goats to consume 4.5% of their body weight in dry matter/day (Devendra, 1975). In conjunction with higher dry matter intake, goats also have a larger proportion of their body weight occupied by mammary gland tissue compared
to cows. Generation interval also favours goats as milk producers since they can be producing milk in tropical conditions by one year of age in contrast to cows who are usually not productive until 3-4 years of age (Devendra, 1980a). These facts indicate that goats could be more economical than cows. However, their role in milk production may be more important as a complement to large scale cow dairies, where goats could provide household milk in rural areas not easily supplied with commercial milk.

Fiber production

Although fiber (mohair and cashmere) producing goats comprise a relatively small percentage of the world goat population, it is in this sector that the most highly developed goat production systems are found. Current Australian interest in goats also focuses on this sector. The efficiency of fiber production in Angoras appears very lucrative. Gallagher and Shelton (1972) compared Rambouillet sheep with Angoras and reported that young goats were 3.1 times more efficient at conversion, of digestible energy to fiber than lambs. Mature goats were 2.7 times more efficient than mature sheep. (Table 4) Although low numbers of animals and crude methods reduced the accuracy of this experiment, the tremendous differences in efficiency cannot be overlooked. The reason for this difference appears to be related to partitioning of nutrients in Angoras that favours fiber production over liveweight gain. Lambs gained 2.8 times more weight/day than kids and efficiency of gain seemed to favour lambs. In a trial comparing Australian Angoras and Merinos, Throckmorton and Ffoulkes (1981) found similar results favouring lamb growth over kid growth on semi-purified diets, with bypass protein and starch. An important observation from the Gallagher and Shelton study is that a marked difference in liveweight gain and conversion of feed to gain was not evident in mature goats and sheep. In environments devoted to fiber production where weight gain is often considered only in terms of maintenance and reproduction, the potential for Angoras may be quite high. One constraint is that environments suitable for Angoras must be relatively free of burr-type plants since vegetable fault cannot be removed by carbonisation without reducing quality. The Australian economics of Angoras in comparison to Merinos has been reviewed by Evans (1981) and available data suggests that gross margins/ha from commercial mohair production could markedly exceed those for a Merino enterprise.

TABLE 4* Clean fiber production, liveweight gain and digestible energy intake in goats and sheep

<table>
<thead>
<tr>
<th>Item</th>
<th>Goats</th>
<th>Sheep</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Mature Young</td>
<td>Mature Young</td>
</tr>
<tr>
<td>Clean fiber, g/day</td>
<td>12.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Liveweight gain, g/day</td>
<td>43</td>
<td>67</td>
</tr>
<tr>
<td>Digestible energy intake,</td>
<td>2740</td>
<td>3900</td>
</tr>
<tr>
<td>kcal/day</td>
<td>1850</td>
<td>3510</td>
</tr>
</tbody>
</table>

*Gallagher and Shelton 1972
CONCLUSIONS

It appears that goats possess certain definite advantages over other livestock. There is a real need to conduct more research on goat nutrition and production before a reliable estimate can be determined for the role of goats in Australian agricultural systems. Although good management is a necessity for any successful livestock enterprise, this may be the deciding factor as to whether goats are a boon or a burden. Under extensive conditions where labour is limited such as is found in many parts of Australia, it may not be possible to exploit goat potential without incurring deleterious effects on the environment. In developing countries where manpower is the primary resource, goats may play a more important role in terms of food production. It will be necessary to determine the correct combination of nutrition, genetics and environment before goat potential can be unlocked.

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