Water melons (*Citrullus vulgaris*) as the main source of water for cattle in central Tanzania

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Abstract

A survey was carried out in Berege village, a typical village in the semi-arid area of central Tanzania, to investigate the cultivation methods, productivity, types, storage and uses of water melons (*Citrullus vulgaris*). Different varieties are grown for human consumption (*Tikiti maji*) and for livestock feeding (*Mahikwi*). Production of the livestock variety ranged from 1.6–5.1 tonnes/ha, equivalent to 1.5–4.8 tonnes of water.

An experiment to investigate the potential of water melons (*Mahikwi*) as an alternative to free drinking water for cattle during the dry season in central Tanzania was carried out at the peak of the dry season. Six growing Mpwapwa bulls (1.5 years old), in individual pens, were fed a *Cenchrus ciliaris*-based diet supplemented with *Acacia tortilis* pods (1.5 kg). Three animals received drinking water *ad libitum* and the remainder received fresh water melons *ad libitum* for 4 weeks. Intakes of free water (14.6 kg) and water from the water melons (18.4 kg) were not significantly different ($P>0.05$). Hay intakes of the 2 groups were similar (3.6 vs 3.4 kg).

It is concluded that water melons can be used as an alternative source of water for growing cattle for at least one month during the dry season, with one hectare supplying enough water for a growing bull for about 3–5 months. Further studies with lactating animals for longer periods are warranted.

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Introduction

The importance of water for maintenance, production and reproduction in livestock, as well as the factors influencing water intake and utilisation, have been well documented (French 1956; Hyder *et al*. 1968; Baudelaire 1972; NRC 1978; King 1983). The total water available to the animal includes the quantity drunk, forage water and water produced during the metabolism of proteins, carbohydrates and fats, with drinking water and water in feeds the main sources (French 1956). In semi-arid areas, water content of forages is very low during the dry season, when drinking water becomes the main source of water for livestock. Water points in semi-arid areas are generally far apart, and productivity in the dry season is reduced as animals expend a lot of energy in walking to water and have reduced forage consumption. Moreover, due to high evaporation rates, water sources may contain high concentrations of salt and often toxic elements, which can increase water demands but inhibit water intake (Baudelaire 1972). In semi-arid areas, succulent plants can offer an alternative source of water as well as feed to grazing animals. Some are sufficiently palatable to be preferred, even when drinking water is available, e.g. the juicy herb *Commelina* and the swollen stems of *Pyrenacantha malvifolia* (Field 1975). Water melons (*Citrullus vulgaris*) are available in appreciable quantities in some villages of semi-arid central Tanzania and are used by livestock as a source of water during the dry season (Kusekwa *et al*. 1990).

Based on this information, a study (survey) was initiated to investigate the cultivation methods, productivity, types, storage and uses of water melons in one village in the semi-arid area of central Tanzania. An experiment was conducted to determine the potential contribution of water melons as an alternative to free drinking water for cattle during the dry season in central Tanzania.

Materials and methods

Survey

A survey was carried out in Berege village, located about 30 km south of Mpwapwa township, Dodoma region, in central Tanzania during the harvesting period in April–June 1991. The village is typical of the semi-arid areas of central Tanzania. Rainfall records for the village for the previous 6 years were obtained and rainfall during the trial period was recorded. A small questionnaire was completed by 30 randomly selected farmers, to obtain information on cultivation methods (varieties/types used, planting period, weeding and harvesting time), storage and main uses of water melon fruits.

The farms were visited and the number of water melon plants plus the number of fruits per plant were recorded on 2 randomly selected plots (20m × 20m) on each farm. A number of water melons were selected at random, weighed and sliced to estimate the number and weight of seeds per fruit.

Experiment on water melons as the main source of water

Animals. This study was conducted at the Livestock Production Research Institute, Mpwapwa, in central Tanzania during the peak of the dry season. Six growing bulls (about 1.5 years old) with an average live weight of 171 kg were paired on the basis of live weight and allocated at random to receive either fresh water or water melons as the sole water source, giving 3 animals per treatment.

Feeding. Bulls were penned individually and fed mature *Cenchrus ciliaris* hay (8 kg, as fed) and ground *Acacia* pods (1.5 kg, as fed) daily. The hay was provided as 4 equal feeds at 07.00, 11.00, 14.00 and 17.00 h. A mineral lick (Maclick Super, Welcome Tanzania Ltd), containing Ca (19.95%), P (11.76%), Na (10.26%), Mg (1.10%), Cu (0.16%), Co (0.02%), Fe (0.50%), K (0.006%), I (0.02%), Zn (0.5%), Mn (0.4%), S (0.33%) and Se (0.001%), was available to all animals during the 28-day experimental period. The experimental period was preceded by a preliminary period of 6 days with the animals receiving the same diet.

Before feeding each morning, hay refusals for each animal were weighed to determine intake and a 10% subsample was taken and bulked for the whole measurement period. Bulked samples were later resampled for DM determination.

Animals on Treatment 1 were provided with drinking water, while those on Treatment 2 had no drinking water but were provided with water melons. Approximately 15 kg fresh water melons were chopped for each animal at 07.00 h. The animals in Treatment 1 were given 15 kg water at the same time. Additional water and water melons were supplied to the relevant animals later in the day to ensure that water and water melons were available *ad libitum*. Each morning, the amount of water or water melons remaining from the previous day was recorded and used to calculate daily consumption. Dry matter (DM) concentrations of the *Acacia* pods and *Cenchrus ciliaris* hay were determined to estimate their contribution of water to the animals. Losses of water due to evaporation were not measured but should be reasonably similar for both groups. The animals were weighed at the end of the experimental period.

Experimental design and analysis. The experiment was arranged in a completely randomised design in which the treatments represented drinking water and water melons, while the observed values were daily intake of hay and drinking water or water melons, measured as a response between the 2 groups of animals. The data were analysed using the following model:

$$Y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$$

Where μ = Overall mean
α = Effect due to treatment
ε = Residual (error term).

Results and discussion

Village survey

The mean annual rainfall in Berege village is 475 mm, ranging from 400–550 mm (Figure 1) in 38 days (range 24–48). The rainy season normally starts in November, but may be delayed until January (Figure 2). The rain ends in April–May, and is followed by 6–8 months of dryness. Due to the unreliable and low rainfall, farmers depend mostly on drought-tolerant crops. These include sorghum, bullrush millet, maize and groundnuts. Other crops such as sweet potatoes, lablab, pumpkins, beans, gourds, bambara groundnuts and water melons are intercropped with the cereals.

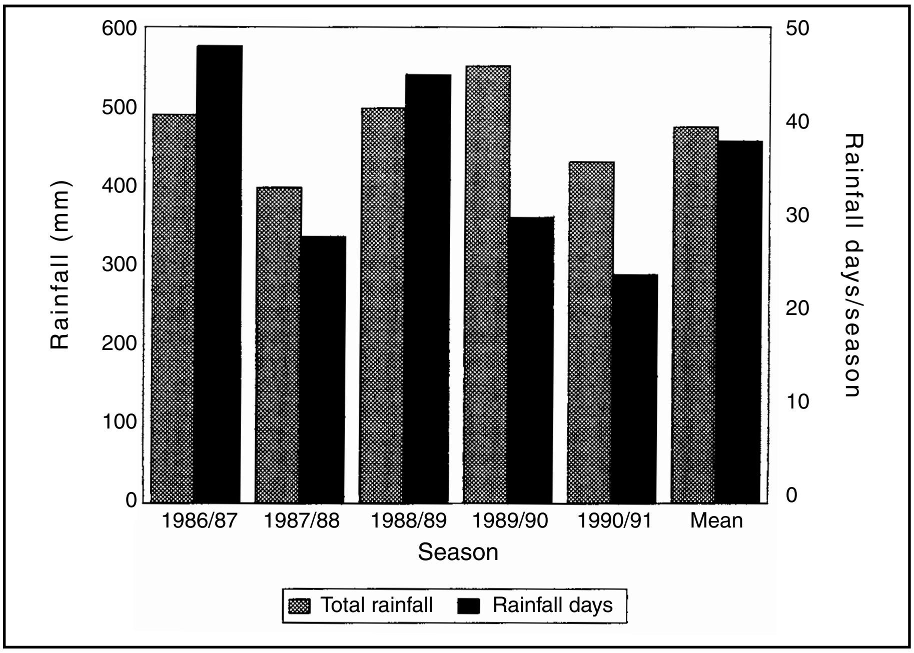

Figure 1. Total seasonal rainfall and number of rain days per season in Berege village for the 1986/87–1990/91 period.

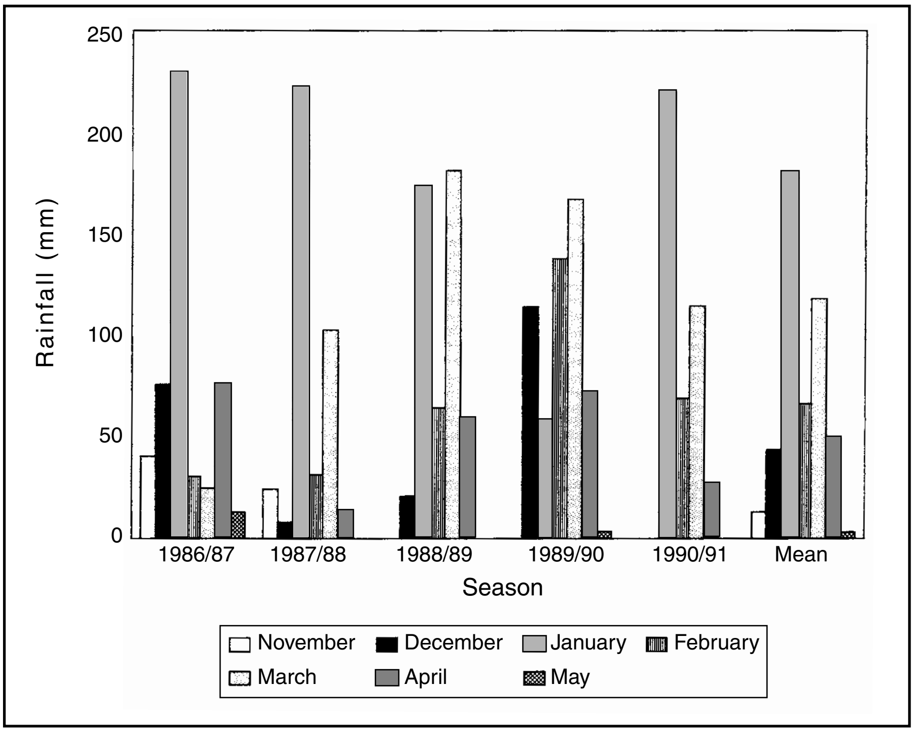

Figure 2. Mean monthly rainfall in Berege village for the 1986/87–1990/91 growing seasons.

As in many of the villages in the semi-arid areas of Tanzania, farmers obtain water from up to 15 km away during the dry season. This amount of water usually fails to satisfy both domestic and livestock requirements, so some supplementary water for the livestock is obtained by feeding them with water melons. There are basically 2 major types of water melon in Berege village: a sweet variety ("*Tikiti maji*") normally consumed by people; and a second variety ("*Mahikwi*") with little sugar content, mainly for livestock and seldom consumed by people. Unfortunately, most information on water melons in the literature relates to the sweet varieties, with very little on the low sugar varieties. Different strains of "*Mahikwi*" are identified by the colour and colour pattern of the fruit and seeds, shape of the fruit and the size of the leaves and fruit. Fruit may be oval, egg-shaped, or long and roundish, while their colour may be cream or deep dark green with or without white stripes and white spots. Seeds are red, black or brown, and the size of the leaves may be broad or small. Some types of water melon have large fruit while some have small fruit, locally called "*Manyenjele*". The most common varieties have broad leaves and produce large, oval fruit with red seeds.

Water melons are planted with cereal crops at the onset of the rains in December–January. Some farmers plant stored seeds, while others depend on germination of seeds from fruit left in the field during the previous season.

The vines start flowering in February, and melons are ready for harvesting in March–April (sweet variety) or May–June (livestock feed types). No farm operations are directed to water melons alone. Weeding is done mainly for the cereal crops and water melons benefit. Farmers have no evidence of any negative effects on productivity of intercropping of the cereals and water melons. Studies carried out by Olasatan (1988) on intercropping of water melons with maize, showed that intercropping raised soil temperature in the upper 10 cm at 06.00 h, and reduced it between 10.00–16.00 h. Soil moisture was 30% higher than with pure stands of maize. However, total water melon biomass and yield of seeds were reduced by intercropping, although maize growth characteristics were unaffected.

With good storage, water melons may remain fresh until the start of the next rainy season. Water melon fruits require cool and dry storage places, and in Berege village, they are stored on raised floors made of sticks and wood, or on the roofs of the houses. Water melons are best stored at high temperatures (e.g. 17–18°C compared with 5–6°C) and should not be stored under protective coverings, such as sawdust (Krikava 1984).

The sweet variety of water melons is consumed by household members, sold to neighbours or to urban areas. "*Mahikwi*" are used extensively for cattle, donkeys, pigs and sick animals as the main source of water and nutrients during the dry season. However, in years of famine, the rind is dried and used to make porridge. A few farmers extract oil from the melon seeds for cooking. In some countries, such as Nigeria, the seed kernels of water melons are used in soups (Okiemen and Onyenkpa 1989). Kamel *et al*. (1985) reported that the extracted oil from water melon seeds was edible, while the meal was used as animal feed. These authors reported that the unsaturated fatty acid content of the ether extract in water melon seeds was 76.1%, comprising mainly linoleic acid.

The majority (80%) of the farms (n = 30) in Berege village had water melon plant population densities ranging from 40–60 (mean = 50) per hectare, with 7–15 (mean = 11) fruits per plant. The average weight of water melon fruits (n = 283) was 5.7 (±2.3 SD) kg. Therefore, average production of water melons (280–900 fruits/ha) is equivalent to 1.6–5.1 tonnes/ha fresh melons. The proportions of dry seeds and rind in fresh water melon fruits (n = 51) were 1.8% and 3.3%, respectively. This indicates that one hectare can produce 1.5–4.8 tonnes of water and 30–95 kg of dry seeds. However, the farmers indicated that water melon production during the year of the survey (1991) was low, due to late and insufficient rainfall (Figures 1 and 2). During this year, it rained for 4 months only. Kusekwa *et al*. (1990) reported higher production (5–10 tonnes/ha) of water melons in Berege village.

Generally, production of water melons has increased since the introduction of improved dairy cattle to Berege village in 1986. Farmers with cattle use melons for livestock feeding, increasing the value of melons as a source of income. Seeds from both varieties of melons are collected by farmers for inclusion in the diets of zero-grazed cattle. The seeds are slippery, and although many are swallowed, most slip from the mouths of the cattle into the feeding containers, where they are easily collected by farmers.

Table 1. Daily intakes (kg/hd/d) of water, water melons and mature hay by growing bulls.[1]

Treatment	Free water	Water melons		Hay		*Acacia* pods		Total	
		Water	DM	Water	DM	Water	DM	Water	DM
Water	14.64	—		0.23	3.41	0.15	1.35	15.02	4.76
Melons	—	18.36	0.92	0.21	3.18	0.15	1.35	17.80	5.13
s.e.	2.79	2.79			0.21			2.79	0.20

[1] None of the treatment differences was statistically significant (P>0.05).

Experiment on water melons as the main source of water

The bulls accepted the fresh water melons readily by the second day after introduction. Intakes of water, fresh water melons and mature hay by the bulls are shown in Table 1.

Treatment had no significant (P>0.05) effect on total water or hay intakes. The amounts of water either drunk daily (14.6 kg) or supplied from water melons (18.4 kg) were in agreement with the daily intakes by 1.5-year-old grade European oxen (3/4-grade Ayrshires) of 18.5 and 16.4 kg, when watered once daily or every second day, respectively (French 1956). Although Williamson and Payne (1978) suggest that cattle require access to free water at all times, there was no indication that free water was needed by the group of bulls receiving water melons only, as no stress or health problems were observed. Liveweight gains for the animals in both treatments during the one month of feeding were 5.4 (±1.3 s.e.) kg and 6.6 (±1.3) kg for those in Treatments 1 and 2, respectively. Hay intake was not affected by lack of free drinking water, and total DM intake exceeded the accepted levels of about 3% of liveweight for cattle (Le Houerou 1980). From this experiment, therefore, it is evident that fresh water melons can be used as a substitute for drinking water for young bulls for at least one month during the dry season.

Conclusion

Utilisation of water melons as the main source of water for livestock will eliminate the losses of energy experienced by cattle when walking long distances to watering points, and will reduce disease risk from contact with other animals. One hectare is capable of producing sufficient water melons to supply water to a growing bull for about 3–5 months in an average year. In years with good rainfall, production may increase up to 10 t/ha as reported by the farmers and the findings of Kusekwa *et al*. (l990), which would support 3 growing bulls for about 5.5 months. Longer-term studies should be conducted to determine if any adverse consequences occur when water melons provide the only water supply for prolonged periods. It is important that such studies involve groups of livestock with higher water requirements than growing bulls e.g. lactating cows.

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