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STUDIES ON ANIMAL TRACTION IN NORTH-WESTERN NIGERIA: II. EVALUATION OF THE EFFICIENCY OF DIFFERENT BREEDS/SPECIES FOR DRAUGHT POWER

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Target audience: Animal scientists, policy makers, farmers.

ABSTRACT

The study was carried out with the aim of evaluating the draught efficiency of animals used for draught in north-western Nigeria. Thus 24 draught bulls (six each of Gudali, Rahaji, Bunaji and Buzu breeds) and six draught camels (consisting of three Red and three White strains) were used in the experiment. The bulls were yoked in pairs while the camels were worked singly making four treatments for bulls, with three pairs of animals in each treatment, and two treatments for camels, with three animals per treatment. The animals were made to plough an area of 1,600 m^2 of uncultivated flat land. During the ploughing exercise, draught force and elapsed working time (EWT) were recorded. Rectal temperature (bulls only) and respiration rate were recorded before and after work. Liveweights of animals were estimated from body measurements. Results showed that the camels weighed significantly ($P < 0.05$) more than the bulls. There were no significant differences in draught force, EWT and speed between either the strains of camels or breeds of bulls. However, inter-species comparison revealed that though the draught force exerted by the paired bulls tended to be higher than that exerted by the single camels, the differences were only significant ($P < 0.05$) between the Bunaji bulls and the White camels. Similar observations were recorded for speed and EWT, where the differences were significant ($P < 0.05$) only between Buzu bulls and Red camels. Changes in respiratory rate after work were higher in bulls (35.5 breaths/min) compared to the camels (11.5 breaths/min), thus indicating a more pronounced state of fatigue for the bulls. Mean increase in rectal temperature recorded for the bulls after work was 1.1 ^oC. It was concluded that the numerical superiority of the bulls, which are normally yoked in pairs, does not translate into higher draught efficiency over camels that are normally worked singly.

Key words: Animal traction; draught animals; breeds; draught power.

DESCRIPTION OF THE PROBLEM

During the last 50 years, many attempts have been made to introduce power mechanisation in African agriculture. Except in few cases, such attempts have completely or partially failed in their objectives. The failure has been attributed to lack of necessary capital and infrastructure as well as

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to the incompetence on the part of the farmers to use such machinery (1). Thus more effort is now being geared towards the use of draught animals to replace hand labour (2). Although animal power cannot reduce human toil to the same degree as mechanical power (3), it can still substantially reduce the number of hours that a farmer has to spend on cultivation. If, in addition, the purchase of the animal is within the financial capacity of the farmer, and the animal provides manure and meat during and after its working life respectively, then the benefits that accrue from the use of animal power are substantial and worthwhile (1).

The two most important factors that influence the efficiency of animal traction are breeds/species and level of nutrition. This is because traction effort is largely dependent on body weight, which, in turn, is influenced by these two variables (4). In Nigeria, cattle are the dominant species used for farm power. It has been reported that in north-central Nigeria, the Bunaji are most often preferred, partly because of their docility (5). In the extreme north-western zones however, the Gudali are often used (6). In addition, camels, which have been used for over 40 years in the Sahel zones of other African countries are also being adopted in this part of the country (6, 7). In a more recent study, it has been shown that the major breeds of cattle used for traction in north-western Nigeria are the Rahaji, the Gudali and the Bunaji breeds, in decreasing order of importance. As for camels the Red strain is often preferred, followed by the White and the Black strains (8). Information on the traction efficiency of these different species, breeds and strains is however lacking. This study therefore aims at evaluating the efficiency of the different species, breeds and strains of animals used for draught. Such information is necessary in order to appropriately advice farmers on the choice of animals to be used for draught purposes. It could also serve as a guide in estimating the energy requirements of these different classes of animals.

MATERIALS AND METHODS

A total of six draught camels (consisting of three Red and three White strains) and 24 draught bulls (six each of Bunaji, Rahaji, Gudali and Buzu breeds) were used in the study. The Buzu breed seems to be a cross between the Rahaji and the Gudali, though the farmers usually refer to it as Rahaji. The camels worked singly - thus the six camels constituted two treatment groups (strains), with three animals per treatment. As for the bulls, they were yoked in pairs - thus the 24 animals constituted four treatments (breeds) with three pairs of animals in each treatment. All the animals (and the implements) were hired from the local farmers, who raise them under the traditional system of management (8).

The animals were made to plough an area of 1,600 m^2 of uncultivated flat land and were operated by their respective owners during the working period. Before the commencement of the ploughing exercise, respiration rate of the animals was recorded by counting the flank movement (9). Rectal temperature was recorded (for bulls only) by use of a clinical

hermometer. Heart girth and body length of the animals were recorded with a measuring tape. These data were used to estimate the body weight of the animals (1, 10). The weights of the plough, the yoke and the chain that connects the two were also recorded.

During the ploughing exercise, the draught force was recorded by using a dynamometer which was attached between the animal(s) and the plough (11). The time spent working - i.e. elapsed working time (EWT) was recorded by use of a stop watch. Soil samples were collected and later analysed for moisture content, bulk density as well as texture. The environmental temperature was also recorded. Rectal temperature (bulls only) and respiration rate were taken again at the end of the ploughing exercise. Information on the estimated age of the animals was obtained from the farmers.

Data were analysed statistically by use of SAS software (12).

RESULTS AND DISCUSSION

The average estimated live weight of the camels (393 kg) was significantly ($P < 0.05$) higher than that of the bulls (139 kg). Differences between breeds and strains for each species were not significant (Table 1). The estimated average age of the camels was 8.5 years as against 6.5 for the bulls.

Table 1. Mean body measurements (cm), estimated liveweight (kg) and estimated age (yrs) of animals.

	Strains of camels		Breeds of cattle			
	Red	White	Gudali	Rahaji	Bunaji	Buzu
Heart girth	226.71	220.00	144.80	145.80	143.83	144.83
Body length	126.67	126.67	71.40	69.60	67.00	78.00
Estimated liveweight	403.00^{b}	382.60^{b}	141.10^{a}	135.28^{a}	127.63^{a}	151.22^{a}
Estimated age	9.00	8.00	6.00	6.00	6.00	8.00

^{a,b} Means on the same line followed by different superscripts are significantly different ($P<0.05$)

Results on draught performance are summarised in Table 2. There were no significant differences in draught force, draught power, speed and EWT between either the strains of camels or the breeds of bulls. Inter-species comparison however revealed that the draught force exerted by the paired bulls tended to be higher than that exerted by the single camels, but the difference was only significant ($P < 0.05$) between Bunaji bulls and the White camels. Similar observations were recorded for speed and EWT, where the differences were significant ($P < 0.05$) only between the Buzu breed of bulls and the Red camels (Table 2). The values of draught force and speed obtained in this study are higher than those reported for Ndama oxen and heifers in Sierra Leone (13, 14). This might confirm the farmers'

observations that bulls are generally stronger than either oxen or heife and hence they have preference for the bulls (8).

Table 2. Mean draught force, speed and elapsed working time

	Strains of camels		Breeds of cattle			
	Red	White	Gudali	Rahaji	Bunaji	Buzu
Draught force (KN)	0.78^{ab}	0.74^{a}	1.09^{ab}	0.83^{ab}	1.13^{b}	0.83^{ab}
Draught power (KW)	0.74^{a}	0.83^{ab}	1.41^{b}	1.06^{ab}	1.40^{b}	1.19^{ab}
Speed (m/s)	0.95^{a}	1.12^{ab}	1.25^{ab}	1.26^{ab}	1.26^{ab}	1.38^{b}
EWT (min)	38.0^{a}	44.3^{ab}	48.2^{ab}	49.0^{ab}	49.0^{ab}	55.0^{b}

a,b Means on the same line followed by different superscripts are significantly different ($P<0.05$)

Calculated draught power indicated that the Gudali bulls had the highest ($P < 0.05$) draught power of 1.41 KW while the Red camels had the least (0.74 KW) (Table 2). There were no significant differences between breeds/strains of animals in terms of draught power. Although the average draught power of bulls (1.26 KW) was higher than that of camels (0.78 KW), it must be borne in mind that the bulls worked in pairs whereas the camels worked singly. If the bulls were to work singly, their expected draught power would be about 0.63 KW - which is lower than that of the camels. These results therefore confirm the importance of the effect of liveweight on draught power (4).

The average speed of the bulls was 1.29 m/s compared to 1.03 m/s for the camels. The draught force exerted by the two species was 0.97 KN and 0.76 KN, respectively. For both of these parameters, the value recorded for the bulls was 1.3 times higher than that recorded for the camels, thus indicating a perfect relationship between draught force and speed of work.

Physiological responses of the animals indicated that signs of fatigue were more pronounced in the bulls compared to the camels. Respiration rates averaged 16.5 and 26.0 breaths/min for camels and bulls respectively before the commencement of the ploughing exercise. Changes in respiration rates after work were higher in bulls compared to camels (Table 3). The values recorded for all the breeds of bulls were significantly ($P < 0.05$) higher than that recorded for the Red camels. For the White camels, the differences were significant ($P < 0.05$) when compared to all the breeds of cattle except the Gudali. There were no significant differences in this parameter between the two strains of camels. Increase in respiration rate after work averaged 11.5 and 35.5 breaths/min respectively for camels and bulls. Thus the increase was 32 % higher in bulls compared to camels. The values obtained for bulls in this experiment is lower than that of 22.24 breaths/min reported for oxen and heifers working for four hours/day (14). This difference can be explained by the shorter working period used in this study.

Table 3. Changes in respiration rate (breaths/min) and rectal temperature (°C) of animals before and after ploughing exercise.

	Strains of camels			Breeds of cattle		
	Red	White	Gudali	Rahaji	Bunaji	Buzu
Respiration rate						
before	16	17	35	21	26	22
after	26	30	61	57	62	67
changes	10^{a}	13^{ab}	26^{bc}	36^{cd}	37^{cd}	43^{d}
Rectal temperature						
before	ND	ND	37.6	38.0	38.0	38.0
after	ND	ND	39.0	39.1	39.0	38.8
changes	ND	ND	1.4^{b}	1.1^{a}	1.0^{a}	0.8^{a}

^{a,b,c,d} Means on the line followed by different superscripts are significantly different ($P<0.050$

ND: Not determined.

Rectal temperature for bulls averaged 37.9 °C before the commencement of the working exercise. Increase in rectal temperature recorded after work averaged 1.1 °C. The Bunaji had the highest ($P < 0.05$) increase of 1.4 °C compared to the other breeds. The increase of rectal temperature recorded here is lower than that of oxen and heifers in Sierra Leone (3.4 °C) (14). As for respiration rate, this difference can also be explained by the shorter period of work in this study.

Type of work done, plane of nutrition and physiological status are among the factors that influence physiological responses of draught animals. Thus higher rise in body temperature and respiration rates were recorded when animals were ploughing compared to harrowing (14). Lower increases in body temperature and respiration rate were also recorded when animals were supplemented with 1 kg ground maize compared to unsupplemented animals (14). Irrespective of the type of work done, heifers have been reported to have 10 % higher respiration rates than oxen (14).

Data generated in this trial tend to point to the fact that the draught efficiency of camels is generally higher than that of bulls. This is because the draught force and speed of the paired bulls were not significantly higher than those of single camels. This could be explained by the significantly higher liveweights of the camels compared to the bulls. Indeed liveweight is one of the most important factors that influence draught efficiency (4). Other factors that influence draught efficiency include the size and weight of implement, topography of the land, soil characteristics, as well as environmental temperature. Table 4 summarises some of these parameters which were recorded during these experiments. The results indicate that there were not much variations in the parameters studied, except for the yoke, the presence of which exerts an extra strain

averaging 12 kg on the bulls. This might have contributed to the relatively lower efficiency of the bulls.

Table 4. Weight of implements, environmental temperature and soil characteristics recorded during the period of experiments.

	Strains of camels		Breeds of cattle			
	Red	White	Gudali	Rahaji	Bunaji	Buzu
Weight of plough (kg)	41	41	41	41	38	41
Weight of yoke (g)	-	-	11	14	13	11
Environmental temp. (°C)	32	33	35	34	34	34
Soil characteristics						
Bulk density (g/Cm^2)	0.017	0.023	0.024	0.017	0.021	0.024
Sand (%)	78.7	78.8	71.0	89.0	77.0	71.0
Clay(%)	7.4	7.4	11.0	6.7	7.0	17.0
Silt (%)	13.8	13.8	18.0	4.3	16.0	12.0

CONCLUSIONS AND APPLICATIONS

It could be concluded that the draught efficiency of camels used in this experiment is higher than that of bulls. Generally there were no significant differences in draught efficiency between the breeds of cattle or the strains of camels used. It must however be pointed out that the results generated in this study must be treated with caution. This is because the experiment was conducted on farm, using animals owned by different farmers, in which case, there is the possibility of variations in certain parameters such as level of supplementation before work, experience of operators, health status of the animals etc. All these can affect the draught efficiency of the animals. Thus, in order to arrive at more solid conclusions, such trials should be conducted on-station so as to allow for the control of these parameters.

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