INVESTIGATION OF THE INTENSIVE FEEDING OF WAKWA AND N'DAMA × WAKWA CROSSES UTILIZING DRIED BREWERS GRAINS IN DERIVED AND GUINEA SAVANNA ZONE IN CAMEROON

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SUMMARY

Long duration feeding trials (over 10 months) using small groups of cattle, primarily Wakwa-N'Dama crosses, were initiated in May 1972 at Obala, Cameroon. Obala is located in the transition zone between Diciduous Forest and Derived Savanna Zones.

The daily ration consisted of 30 kg of fresh cut forage supplemented with equal parts of dried brewers grains and cane molasses. The DBG/molasses concentrate was increased from an initial 5 kg to 8 kg during the trial.

The average daily gain was a little less than 0.50 kg per day over the feeding period. The economic analysis of the trial suggests that at the current price levels, long feeding periods are not profitable but that shorter periods appear to be profitable if special markets can be developed.

RESUME

Recherches sur l'embouche intensive de N'Damas et de métis N'Dama × Wakwa, utilisant des drêches de brasserie sèches en zones de savanes au Cameroun

Des essais d'embouche longue (10 mois) utilisant de petits groupes d'animaux, d'abord des métis Wakwa × N'Dama ont commencé en mai 1972 à Obala au Cameroun. Obala est situé dans la zone de transition entre la forêt décidue et la savane.

La ration quotidienne consistait en 30 kg de fourrage fraîchement coupé, supplémenté par des drêches de brasserie sèches et de la mélasse de canne à parties égales. Le mélange concentré drêches/mélasse a été augmenté de 5 kg au début à 8 kg pendant l'essai.

Les croîts quotidiens moyens ont été un peu inférieurs à 0,50 g pendant la période d'embouche. L'analyse économique de l'essai montre qu'au niveau actuel des prix, l'embouche longue n'est pas profitable, mais des périodes plus courtes apparaissent l'être si des marchés appropriés peuvent être développés.

INTRODUCTION

Throughout the West and Central African Region, the demand for red meat is growing considerably faster than demand and prices are increasing 10-15 percent per year. In fact, there is considerable evidence that percapita availability of red meat is declining in many marketing areas. At the present time the South Cameroon market which includes the Adamaoua Plateau and West Cameroon production areas, is self sufficient in red meat production. However, the percapita availability of red meat (beef, goat and mutton and pork) is less than 9 kilograms per capita (SEDES, 1971).

Several West African countries, notably Cameroon, have extensive areas of potential grazing in the Derived and Guinea Savanna vegetative zones. Problems related to development include low historical cattle and meat prices the shortage of suitable cattle and the general lack of infrastructure in the zones (see papers by BRANCKAERT and FERGUSON this conference). However, rising cattle and meat prices resulting from the growth of demand at a rate faster than supply are expected to permit the profitable development of a cattle industry in these zones in the near future.

An immediate possibility for development are growing-out operations for range cattle currently trecked south through the zone to the Yaounde and Douala markets. The « Programme Viande », outlined in the current *Third National Development Plan*, envisages the development of growing out and fattening ranches in the Derived Savanna Zone south of the Adamaoua Plateau. This development will be facilitated by the completion of the Transcamerounais Rail Road in 1974, linking Ngaoundere with the principal southern markets, permitting low cost transportation of both cattle and feed stuffs.

HISTORY OF THE OBALA STATION

In September 1968, the Department of Zootechnie of the National Advanced School of Agriculture, trans-

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ferred a small demonstration herd of 10 Ndama and 23 Wakwa (3) cattle from the School farm near Yaounde to the grounds of the Centre de Formation Civique et Professionnelle d'Obala, at Obala, 40 kilometers North of Yaounde. The transfer was made necessary by the introduction of Brown Swiss dairy cattle at the School Farm. The Obala location was selected because of the easy access to Yaounde by road and railroad and to supply of agricultural by-products. Those of particular interest were molasses from the SOSUCAM Sugar Estates at M'Bandjock and dried brewers grains produced by the Brasseries du Cameroun in Yaounde. The Obala station is situated in the transition zone between the Diciduous Forest and Derived Savanna Zones at an elevation of 520 meters.

The principal objectives of the station are the following : 1) Demonstration of beef cattle husbandry to the students of NASA and the stagiaires of the center ; 2) Investigates the possibilities of mixed crop and livestock farming in the Derived Savanna and Guinea Savanna Zones ; 3) Investigate the potential for the introduction of improved beef breeds including the Wakwa and Ndama to farmers in forest and savanna zone considered unfavorable to livestock because of climate and trypanosomiasis.

Although the original plans envisaged the expansion of the herd to 250 head and 250 hectares, land pressure near the village of Obala has limited expansion to 21 hectares of improved pasture and forage crops and 40 hectares of unimproved pasture typical of derived savanne pastures in the vacinity. Through the production and feeding of maize silage and stylosanthes hay and the feeding of cotton seed cake and molasses in the dry season, the herd has been expanded to over 120 head.

The Ndama breed has recognized advantages in the Deciduous Forest and Derived Guinea Savanna zones of Western Africa (R). However, the Ndama foundation stock available in Cameroon are few in numbers, largely unselected and very small in size. The breeding program at the station has been to cross breed the available Wakwa and Ndama females with Ndama sires. The objective of the breeding program is to increase the average size of the breeding herd and to take advantage of any heterosis while retaining the greater adoptability of the Ndama to the Derived Savanna zone.

MOLASSES AND DRIED BREWERS GRAINS FEEDING TRIALS

The pioneering work of PRESTON has demonstrated the potential for the utilization of cane sugar molasses in the intensive feeding of livestock in tropical areas. There is little doubt that with the concurrent rise in meat prices and the spread of cane production, the use of molasses as an animal feed will become more common.

The two principal problems associated with using molasses as the principal energy source in ruminant diets are the low fiber and protein contents of molasses. Thus, low cost sources of crude fiber and protein or a protein precurser must be included in the ration. The choices of complements are many and varied. With the utilization of molasses in fattening rations expanding to more countries and areas, the question for research is to identify the locally available feeding stuffs which can be used in conjuction with molasses in complete rations at economic prices. The use of molasses with a wide variety of by-products and forage are being investigated and include : groundnut hulls and rice milling by-products in Senegal (VALENZA et al., 1971) ; cotton seed cake and hay in the Adamaoua Plateau region of Cameroon (LHOSTE et al., 1973) ; fresh cut *Pennisetium purpureum* forage or grain (*Sorghum*) complemented by urea in Cuba ; restricted grazing complemented by fish meal also in Cuba (PRESTON, 1972) ; and dried brewers grains with forage by the National Advanced School of Agriculture discussed in this paper.

While many by-products have limited applicability because availability is limited to a few countries, dried brewers grains would appear to be an exception. The brewering industry is expanding rapidly in tropical countries making wet brewers grains widely available and drying installations to produce dried brewers grains are common. Their advantage as a complement to molasses feeding is that they are a potential source of both digestable crude fiber and digestable protein.

Wet brewers grains represent the solid residue remaining in the fermentation vats after the brewing process is completed. The solids are made up, principally by the glumenous parts of the ground grain used in the malting process to which adhere substances not disolved in the process. It contains some non-fermented starches, the largest part of the pentosanes and fatty acids, the proteins which are not coagulated in the cooking of the mixture and minerals.

The typical analysis of wet brewers grains is given in Table 1. Wet brewers grains contain 75-80 percent water and because of the high content of fermentable products and because it remains for long periods at temperatures favorable to the development of microorganisms, it is susceptible to very rapid spoilage. Therefore, fresh brewers grains must either be utilized quickly or preserved as silage or by drying. The wet grains can only be used in the immediate vacinity of breweries because of prohibitive transport costs for the wet product.

1

Analysis composition of wet brewers grains.

	Minimum	Maximum	Average
	(p.100)	(p.100)	(p.100)
Water	70.0	84.6	77.1
Crude Protein	2.9	7.1	5.0
Eather Extract	1.0	3.2	1.6
Nitrogen Free Extract	3.2	15.4	10.4
Crude Fiber	2.8	9.1	4.6
Ash	0.3	2.1	1.2

Source :

PICCIONI (M.), Dictionnaire des Aliments pour les Animaux (Paris, 1965), Translation of *Dizionario Degli Alimenti Per Il Bestiame*, by J. Hardouin.

A growing number of breweries have equipment for drying the wet grains. First, the wet grains are passed through a press which removes 35-40 percent of the moisture followed by hot air drying at temperatures of 90-100 degrees centegrade which reduces the moisture content to a maximum of 10 percent.

The dried product is of excellent nutritive value for livestock feeding. The results of the analysis of five samples drawn from the Obala trials are given in Table 2. There are rather large variations in fiber content due to differences in the products used in

(3) The Wakwa breed is a cross breed between African Zebu cattle of the Adamaoua type and the American Brahman breed developed at the Centre de Recherches Zootechniques de Wakwa, Wakwa, Cameroun.

making beer, which in Cameroon, is usually either maize or rice. The analysis of the locally available product indicates a feeding value 25 percent superior to those commonly reported in feeding manuels and texts. The average crude protein content of five samples is 24.5 percent and the crude fiber 13.5 percent. Using the digestibility tables of SCHNEIDER (4), the feeding value of the dried brewers grains was 0.67 and the digestible protein 181 g. per kilogram.

2

Dried brewers grains. Results of analysis (+).

Sample Number Date	10428 11/10/71	10435 4/1/72	11005 27/9/72	11645 10/4/73	12044 1/7/73	- x
			(p.100)			
Moisture	12.80	8.65	11.10	12.50	9.00	10.81
Dry Matter	87.20	91.35	88.90	87.50	91.00	89.19
Crude Protein	24.28	24.84	27.87	23.14	22.41	24.51
Crude Fiber	13.55	15.05	11.55	18.20	10.85	13.46
Eather Extract	5.21	5.75	5.70	5.13	5.57	5.67
Ash	3.37	3.58	3.38	3.67	4.70	3.74
N.F.E.	40.79	41.13	40.40	39.36	47.37	41.81
Ca.	0.30	0.29	0.31	0.25	0.68	0.37
P.	0.47	0.51	0.49	0.39	0.39	0.45
Mg.	0.18	0.18	0.19	0.18	0.19	0.18
K.	Traces	Traces	Nil	0.11	0.20	-

(+) Analysis of Samples complements of Dr. Riviere, Labo-Nutrition et Alimentation, I.E.M.V.T., Paris.

In spite of their nearly universal availability and wide usage in temperate countries, there are few published reports of feeding trials on dried brewers grains. Exception are poultry feeding trials reported by KIENHOLZ and THORNTON (1962 and 1964) at the University of Colorado, Fort Collins, Colorado, and broiler (poulets de chair), laying hens, and pork feeding trials conducted by the Department of Zootechnie of the National Advanced School of Agriculture. The later trials have established an optimal feeding rate of 20 percent dried brewers grains in the ration (BRANCKAERT, 1967 ; BRANCKAERT and VALLERAND, 1970 ; BRANCKAERT and VALLERAND, 1972).

The two following ration uncorporating molasses and dried brewers grains are currently being investigated at the National Advanced School of Agriculture as supplemental feeds for sheep fattening and lactating dairy cattle and ewes and riding horses :

	Ration A (Percent)	Ration B (Percent)
Molasses	50	45
D.B.G.	50	45
Urea	—	2
Salt	—	2
Bicalcium Phosphate	—	6

Ration A provides 0.7 UF per kilogram and approximately 12.5 percent crude protein and is supplemented with a mineral mixture containing 10 percent phenothiazine fed free choice. Ration B provides 0.7 UF per kilogram and the equivalent of 14.5 percent crude protein.

The results of the sheep fattening trials are reviewed in the note to this conference « Utilisation des drêches mélassées dans l'engraissement du mouton Djallonke », (See paper by BRANCKAERT and VALLERAND). The results of the sheep fattening trials suggest that with fattening sheep, the energy conversion is 11-12 UF per kilogram of gain or approximately the same as that of zebu cattle.

For the past several years, Ration A has been used with excellent results as a concentrate feed for riding horses replacing grain in the ration. Ration B is being successfully used as a concentrate feed for lactating dairy cows and ewes and is fed at the rate of 1.0 kg of concentrate per 2 kg of milk produced.

It is worth noting that in 1967, all the dried brewers grains produced in Cameroon were exported. But as the result of the poultry and pork trials, the entire production of dried brewers grains is now used within Cameroon, and a ministerial decree forbids export of this valuable animal food stuff. However, several new breweries without drying facilities have been constructed since 1969. The management of Cameroon Breweries (Brasseries du Cameroun) has indicated an interest in installing new drying facilities if profitable markets can be identified. It is with the goal of identifying markets for agricultural by-products that Cameroon Breweries and SOSUCAM sugar estates have provided dried brewers grams and molasses respectively, without cost for the feeding trials conducted by the National Advanced School of Agriculture.

OBJECTIVES AND RESULTS : BEEF FEEDING TRIALS

The zootechnic, pedagogic, and demonstration objectives, the severe pasture constraint of the station and the small number of cattle available for feeding, influenced the feeding trials to be undertaken. Fifteen steers ranging in age from 8 to 25 months were divided by age into three groups of five animals each (5). The average age, weight length of trial in days and breed were the following :

	Average Age (da)	Average Weight (Kgs.)	Days on Trial (da)	Remarks
Group I ..	620	249.4	308	1 Wakwa 4 Metis
Group II ..	456	198.4	351	1 Wakwa 4 Metis
Group III .	273	153.2	(continuing)	5 Metis

(4) Feeds of the World. Their Digestibility and Composition (West Virginia University, U.S.A., 1947).

(6) A Sixth animal (Metis) originally in Group I was removed from the trial because of negative weight gains. The animal subsequently died of unknown cause, believe to be unrelated to the trial.

Group I and II consisted of 1 pure Wakwa and 4 Metis — Ndama × Wakwa, Group III, 5 Metis. They were placed in identical pens measuring 50 sq meters. Shade and protection for the feed bunk were provided by an aluminium roof measuring 10 sq meters. The molasses/grain were mixed daily and feed in the morning and afternoon. Depending on the season, either Guatamala grass cut daily or *Stylosanthes* hay were fed free choice. Roughly 30 kg. of fresh cut grass and 8 kg. hay were provided. No records are available of quantities not consumed. A complete mineral mixture which contained 10 percent phenothiazine was fed free choice in one end of the feed bunk.

The requirements of the animals used in the feeding trials were estimated to be between 2 and 3.5 UF per day for maintenance and between 2.7 and 3.0 UF per day for growth. These estimates were based on those for European breeds because the precise requirements of African breeds are not known. Assuming an expected growth rate of 750 g/day, the daily requirement for group I, which entered the trial at 250 kilos at an average age of 24 months are compared with the experimental ration in Table 3.

3

Daily requirements compared to those provided on feed lot. Animals of 250 kg and 24 months of age. Average Gain Per Day Kg.

	(Recommendations) UF (Units)	Digestable Protein (gms.)
Maintenance	2.7	150
Growth	2.8	450
Total	5.5	600
(Experimental Ration (Begin Trial)		
Fresh Forage (30 kg)	3.3[a]	330
DBG/Molasses (5 kg)	3.5	450
Total	6.8	780
(Experimental Ration (End Trial)		
Fresh Forage (30 kg)	3.3[a]	330
DBG/Molasses (8 kg)	5.6	720
Total	8.9	1 050

[a] Guatamala Grass

It would appear that both the energy and protein provided by the experimental ration exceeds the daily requirements as currently understood. However, the results of the trials must be interpreted with caution for two reasons :

1. The lack of precise data as to the feed conversion rates typical of African breeds illustrated by the large variations in these estimates observed in the literature ;

2. We regret to note that the persons responsible for the daily supervision of the feed lots may not have taken adequate precaution throughout the trial to assure timely feeding and accurate measurement of rations and fodder for the feed lots.

While admitting these problems of interpretation, we feel that the results do contribute in a small but significant way to the knowledge of feeding African zebu cattle.

The results for Groups I and II are given in Tables 4-6 and in Appendix Tables I, II, III, and IV. Because Group III continues on trial, only a summary of growth rates are given as part of Table. The feeding trials were continued beyond the customary periods of 30-100 days because of the comparatively young age of animals placed on feed and the shortage of pasturage on the station. Because it was not known how animals would react physiologically to intensive feeding, the molasses/DBG mixture was increased in four steps from an initial 3.2 kg. per day to 8.0 kg. per day in the 20th week.

Weight gain and average daily gain per two week intervals, molasses/grain feeding rate and cumulative feed cost are given in Table I and II. The considerable variation is weight gain by two period is believed to reflect inaccurate weight recording and occasional lapses by supervisory staff in assuring timely and accurate feeding. The decline in average weight gain after 10 weeks (which occurred during the October period of heavy rains) was corrected by increasing the molasses/DBG mixture. A summary by convenient recording periods for the three groups and the 2 Wakwa and 8 Metis in Group I and II are given in Table 4.

The average daily gain for 98, 168, 138, and 308 day feeding periods were the following :

Group/Period	0-98	99-168	169-238	239-308	0-308
Group I	.590	.314	.517	.426	.473
Group II	.596	.340	.483	.454	.480
Wakwa (2)	.683	.243	.543	.379	.504
Metis (8)	.570	.348	.464	.455	.470
Average	.592	.327	.500	.440	.476

Average daily gains were highest in the initial 98 day periods averaging. 592 kgs. per day and averaged. 476 kgs. per day for the 308 day period. The 2 Wakwa gained on average. 025 kgs. more per day during the 308 day period. However, because the groups are small and of mixed breeding and the grain/molasses mixture was restricted, no conclusion is possible concerning the comparative efficiency of feeding Wakwa versus Ndama/Wakwa crosses. The growth rates obtained in this trial are compared with other feeding trials in another paper at this Conference (BRANCKAERT, 1973).

4

Groups I, II and III.
Average weight and average daily gain, 98, 168 and 308 day * feeding periods.

	Begin Trial		98 Days		168 Days			238 Days			308 Days		
Group	Ave. Age (da.)	Wt.	Wt.	Ave. Daily Gain	Wt.	Daily Gain Period	Daily Gain Trial	Wt.	Daily Gain Period	Daily Gain Trial	Wt.	Daily Gain Period	Daily Gain Trial
Lot I	645	249.4	307.2	.590	328.2	.314	.475	365.4	.517	.487	395.2	.426	.473
Lot II	462	198.4	256.8	.596	280.6	.340	.489	314.4	.483	.487	346.2	.454	.480
Wakwa (2)	544	237.5	304.5	.683	321.5	.243	.500	366.5	.643	.542	393.0	.379	.504
Metis (8)	598	220.5	276.4	.570	300.1	.348	.478	333.3	.464	.474	365.1	.455	.470
Average I + II	555	223.9	282.0	.592	304.9	.327	.482	339.9	.500	.487	370.7	.440	.476
Lot III	273	153.2	194.8	.424	230.4	.508	.460	267.8	.657	.534	276.4	.134	.400

(*) Source : Tables 1 and 11.

GROSS FEEDING MARGINS

Although the principal objectives of the trials were to investigate the zootechnic aspects of feeding molasses/DBG, a rough estimates of the gross feeding margin at convenient points in the trial are possible. Selected productivity estimates, carcass value, and value of the animal, and estimated gross feeding margin for each group are given in Tables III and IV for 98, 168, 238, and end trial period. Those for 98 days and end trial for groups I and II are given in Table 5. Actual carcass percentages for the two groups at slaughter are given in Table 6. It should be noted that at the end of the trial, Groupe II obtained an average carcass percentage of 56 percent and Group I, 55 percent.

It was necessary to estimate the carcass percentage (KOP), carcass weight and the value of the carcass for the earlier periods. Prices per kilogram reflect prevailing Yaounde wholesale prices, for carcasses of modest to excellent quality depending on the degree of finishing at each stage. The end of trial price was CFA 180 per carcass kilogram.

The feeding margin at 98 days and end of trial were the following :

	Feeding Margin	CFA
Group I (*)	98 days	3,590
	308 days	4,085
Group II (**)	98 days	3,330
	351 days	1,251

(*) Average age begin trial 20 months.
(**) Average age begin trial 15 months.

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Groups I and II : Productivity estimates, carcass value and animal value feed cost and estimated returns, 98 day and end trial.

	Group I			Group II		
	Begin Trial	98 Days	308 Days	Begin Trial	98 Days	351 Days
Ave. Live Wt. (kg)	249	307	395	198	257	363
KOP (est) (p.100)	50	52	56	50	52	55
Carcass Wt (kg)	125	160	221	99	134	200
Carcass Value/kg (CFA)	150	160	180	150	160	180
Ave. Carcass Value (CFA)	18,750	25,600	39,760	14,850	21,440	36,000
Weight offals (kg)	20	25	32	16	21	29
Value Offals (CFA)	1,400	1,750	2,240	1,120	1,470	2,030
Value Animal (CFA)	20,150	27,350	42,020	15,970	22,910	38,030
Increase Value (CFA)	-	7,200	21,870	-	6,940	22,060
Feed Cost (CFA)	-	3,610	17,785	-	3,610	20,809
Feeding Margin (CFA)	-	3,590	4,085	-	3,330	1,251

Source : Tables 3 and 4.
For footnotes, see Tables 2 and 4.

6

Groups I and II : Final weight, carcass weight and carcass percentage nine animals.

Lot	Weight One Week Before Slaughter	Weight After Fasting	Cold Carcass Weight	Carcass Percentage
	(kg)	(kg)	(kg)	p.100
Lot I				
008 M	382	369	200	54.2
010 W	445	437	242	55.8
020 M	416	404	225	56.3
022 M	381	384	215	55.5
024 M	374	382	210	54.5
Average (5)	399	395	218	55.3
Lot II				
Average (4)[a]	369	372	205	55.1

[a] One animal (Metis) remains on trial.

The feeding margin for Group I was an estimated CFA 3,590 after 98 days and increased by only CFA 495 for the additional 210 days. That for Group II was an estimated CFA 3,330 after 98 days and because feed cost exceeded the increase in animal value, declined by CFA 2,079 for the following 253 day feeding period.

The research station milieu and the small groups available for feeding at the Obala station did not permit a synthesis of overhead costs of potential commercial ranch operations based on the trials. However, a preliminary analysis of hypothetical costs suggests that a minimum margin of CFA 2,000-2,500 per month would be required for a profitable commercial operation. The intensive feeding of animals of the type and weight utilized in trial would be at best marginally profitable for short feeding periods of up to 98 days at current price levels for inputs and meat. Longer periods on feed which require higher levels of feeding to obtain comparable weight gains are not profitable at the present time. However, should cattle of a uniform type and weight be available in larger numbers, it should be possible to develop a specialized market either locally or for export for high quality meat which could justify intensive feeding for the shorter period of 98 days.

APPENDIX TABLES

1

Molasses and dried brewers grains feeding trial :

Group I, average weight, weight gain, rate concentrate feeding and feed cost two weeks intervals (1 Wakwa, 4 Métis).

Week	Average Weight	Weight Gain Two Weeks	Daily Weight Gain	Concentrate Daily[a]	Cumulative Feed Cost[b]
	(kg)	(kg)	(kg)	(kg)	(CFA)
0	249.4	-	-	3.2	-
2	255.6	6.2	.443	3.2	448
4	267.8	12.2	.871	3.6	901
6	279.0	11.2	.800	4.0	1,405
8	288.8	9.8	.700	4.0	1,909
10	296.4	7.6	.543	4.0	2,413
12	294.0	-2.4	-.171	4.5	2,980
14	307.2	13.2	.943	5.0	3,610
16	307.0	-0.2	-.014	5.0	4,240
18	310.0	3.0	.214	5.0	4,870
20	315.0	5.0	.357	6.5	5,689
22	324.2	9.2	.657	8.0	6,697
24	328.2	4.0	.286	8.0	7,705
26	331.6	3.4	.243	8.0	8,713
28	341.2	9.6	.686	8.0	9,721
30	352.2	11.0	.786	8.0	10,729
32	355.2	3.0	.214	8.0	11,737
34	356.4	1.2	.086	8.0	12,745
36	374.2	17.8	1.271	8.0	13,753
38	387.8	13.6	.971	8.0	14,761
40	387.4	-0.4	-.029	8.0	15,769
42	402.2	14.8	1.057	8.0	16,777
44	339.0[c]	-9.2	-.657	8.0	17,785

[a] Fifty percent molasses and brewers dried grain concentrate mixture.

[b] Estimated cost molasses CFA 3 per kg and actual cost dried grains CFA 15 per kg.

[c] Weight for fasted animals immediately before slaughter.

2

Molasses and dried brewers grains feeding trial :

Lot II, Average weight, weight gain, rate concentrate feeding and feed cost, two weeks intervals (3 Wakwa, 2 Métis).

Week	Average Weight	Weight Gain Two Weeks	Average Daily Gain	Concentrate Daily[a]	Cumulative Feed Cost[b]
	(kg)	(kg)	(kg)	(kg)	(CFA)
0	198.4	-	-	-	-
2	202.0	3.6	.257	3.2	448
4	214.0	12.0	.857	3.6	901
6	224.6	8.6	.614	4.0	1,405
8	233.2	8.6	.614	4.0	1,909
10	238.8	5.6	.400	4.0	2,413
12	247.6	8.8	.629	4.5	2,980
14	256.8	9.2	.657	5.0	3,610
16	255.2	-1.6	-.114	5.0	4,240
18	262.2	5.0	.357	5.0	4,870
20	267.2	5.0	.357	6.5	5,689
22	279.0	11.8	.843	8.0	6,697
24	280.6	1.6	.114	8.0	7,705
26	285.2	4.6	.329	8.0	8,713
28	287.8	2.6	.186	8.0	9,721
30	299.2	11.4	.814	8.0	10,729
32	306.6	7.4	.529	8.0	11,737
34	314.4	7.8	.557	8.0	12,745
36	322.8	8.4	.600	8.0	13,753
38	330.2	7.4	.529	8.0	14,761
40	333.8	3.6	.257	8.0	15,769
42	349.0	15.2	1.086	8.0	16,777
44	346.2	-2.8	-.200	8.0	17,785
46	351.6	5.4	.386	8.0	18,793
48	359.8	8.2	.586	8.0	19,801
50	363.0[c]	5.2	.229	8.0	20,809

[a] Fifty percent molasses and brewers dried grain concentrate mixture.

[b] Estimated cost molasses CFA 3 per kg and actual cost dried grains CFA 15 per kg.

[c] Weight for fasted animals immediately before slaughter.

3

Group I : productivity estimates, carcass value and animal value feed cost and estimated returns per animal 98, 168, 238 and 308 day feeding periods (+) (4 Metis, 1 Wakwa).

Item		Begin Trial 9/5/72	98 Days 26/8/72	168 Days 4/11/72	238 Days 13/1/73	308 Days 24/3/73	End Trial Increase
Ave. Live Wt.	(kg)	249	307	328	365	395	146
K.O.P.	(p.100)	50	52	53.5	55	56	6
Carcass weight.	(kg)	125	160	175	201	221	96
Carcass Value/kg	(CFA)	150	160	170	175	180	30
Value Carcass	(CFA)	18,750	25,600	29,750	35,175	39,780	21,030
Weight Offals	(kg)	20	25	26	29	32	12
Value Offal at CFA 70	(CFA)	1,400	1,750	1,820	2,030	2,240	840
Value Animal	(CFA)	20,150	27,350	31,570	37,205	42,020	21,870
Increase Value	(CFA)	-	7,200	4,220	5,635	4,815	21,870
Feed Cost	(CFA)	-	3,610	4,095	5,040	5,040	17,785
Feeding Margin	(CFA)		+3,590	+ 125	+ 595	- 225	+4,085

(+) Carcass Weight, K.O.P. and values for carcass and offals estimated for 98, 168, 238 day periods. Those for 308 days are for fasted animals at time of slaughter.
Feed costs from Table 1, weight of offal estimated as 8 percent of live weight.
Prices for carcass and offal reflect current Yaoundé wholesale prices.

4

Group II : Productivity estimates, carcass value and animal value feed cost and estimated returns per animal 98, 168, 238, 308 and 351 day feeding periods (+) (2 Metis, 3 Wakwa).

	Begin Trial 9/5/72	98 Days 26/8/72	168 Days 4/11/72	238 Days 13/1/73	308 Days 24/3/73	351 Days 5/5/73	End Trial Increase
Ave. Live wt.	198	257	281	314	346	383	185
KOP (est.)	50	52	53	54	55	55	5
Carcass wt.	99	134	149	170	190	200	101
Carcass Value/kg (CFA)	150	160	170	175	180	180	30
Value Carcass (CFA)	14,850	21,440	25,330	29,750	34,200	36,000	21,150
Wt. Offals (kg)	16	21	23	25	28	29	13
Value Offals (CFA)	1,120	1,470	1,610	1,750	1,960	2,030	910
Value Animal (CFA)	15,970	22,910	26,940	31,500	36,160	38,030	22,060
Increase Value (CFA)	-	6,940	4,030	4,560	4,660	1,870	22,060
Feed Cost (CFA)	-	3,610	4,095	5,040	5,040	3,024	20,809
Feeding Margin (CFA)	-	3,330	- 65	- 480	- 380	-1,154	+1,251

(+) Carcass weight, K.O.P., and values for carcass and offals estimated for 98, 168, 238, 308 day periods. Those for 351 days are for fasted animals at time of slaughter.
Feed costs from Table 2, Weight of offal estimated at 8 percent of live weight.
Prices for carcass and offal reflect current Yaoundé wholesale prices.

BIBLIOGRAPHIE

BRANCKAERT (R.), « Utilisation des drêches de brasserie desséchées dans l'alimentation du poulet de chair en régions tropicales », *Rev. Elev. Méd. vét. Pays trop.*, v. 20, n° 4, 1967.

BRANCKAERT (R.) et VALLERAND (F.), « Utilisation des drêches desséchées dans l'alimentation animale en régions équatoriales et tropicales, II, La poule pondeuse », *Revue Elev. Méd. vét. Pays trop.*, v. 23, n° 2, 1970.

BRANCKAERT (R.) et VALLERAND (F.), « Utilisation des drêches desséchées dans l'alimentation animale en régions équatoriales et tropicales, III, Le porc », *Rev. Elev. Méd. vét. Pays trop.*, v. 25, n° 1, 1972.

BOUD (T.-E.), « Kenya. The Design and Construction of Beef Feed lots », AGA/SF/69/520, F.A.O., 1972.

Cameroun, Ministère du Plan et de l'Aménagement du Territoire, *Troisième Plan Quinquennal de Développement Economique et Social* (Yaoundé, 1972).

CREEK (M.), « Le Projet de parcs d'engraissement au Kenya », *Revue Mondiale de Zootechnie*, n° 3, 1972.

COULOMB (M.), « Essai d'engraissement intensif de zébus de boucherie (Minankro - Bouake) », Colloque O.C.A.M., Fort-Lamy, 1969.

DEAN (D.) and JOHNSON (D.), « Beef cattle production on the Adamaoua Plateau (U.S. Peace Corps in Cooperation with the United Republic of Cameroon, Ministry of Elevage, 1972).

DUMAS (R.) et LHOSTE (P.), « Variations du poids vif et du rendement en viande de bœufs zébus de l'Adamaoua au cours de la saison sèche », *Revue Elev. Méd. vét. Pays trop.*, v. 19, n° 4, 1966.

DUMAS (R.) and LHOSTE (Ph.), « Crossing between local zebu and American Brahman breed in Adamawa », 2nd. World Conference on Animal Production, University of Maryland, 1968.

DUMAS (R.) and LHOSTE (Ph.), « Effect of seasonal factors on the weight variations and meat production of Adamawa Zebus », Second World Conference on Animal Production, University of Maryland, 1968.

DUMAS (R.) et LHOSTE (Ph.), « La production de viande bovine en Adamaoua camerounais », Colloque O.C.A.M., Fort-Lamy, 1969.

IBRD, Permanent Mission in Western Africa « Livestock Development in Western Africa », IBRD, PBWA, Abidjan, November 24, 1972, mimeo.

JOUVE et LETENNEUR, « Essais d'embouche intensive de zébus maliens en Côte-d'Ivoire », *Rev. Elev. Méd. vét. Pays trop.*, v. 25, n° 2, 1972.

KIENHOLZ (E.-W.), « Brewers dried grains as a protein supplement in chicken, starter, layer and breeder diets », Feedstuffs, v. 34, n° 15, 1962.

LACROUTS (M.-M.) et SARNIGUET (J.), « Le cheptel bovin du Cameroun. Exploitation, commercialisation - Perspectives d'avenir », deux tomes (Ministère de la Coopération, mars 1965).

LHOSTE (Ph.), « Comportement saisonnier du bétail zébu en Adamaoua camerounais, 1, Femelles adultes », *Rev. Elev. Méd. vét. Pays trop.*, v. 20, n° 2, 1967.

LHOSTE (Ph.), « Comportement saisonnier du bétail zébu en Adamaoua camerounais, 2, Croissance », *Rev. Elev. Méd. vét. Pays trop.*, v. 21, n° 4, 1968.

LHOSTE (Ph.), « Les races bovines de l'Adamaoua », Colloque O.C.A.M., Fort-Lamy, 1969.

LHOSTE (Ph.) et coll., « Embouche intensive des zébus de l'Adamaoua, 1, Comparaison de différents systèmes d'alimentation », *Rev. Elev. Méd. vét. Pays trop.*, v. 25, n° 2, 1972.

LHOSTE (Ph.) et coll., « Embouche intensive des zébus de l'Adamaoua, 2, Influence de la durée de la période d'embouche », *Rev. Elev. Méd. vét. Pays trop.*, v. 25, n° 2, 1972.

LHOSTE (Ph.), PIERSON (J.) et GINISTRY (L.), « Essai de finition de bœufs zébus avec utilisation maximale de mélasse », I.E.M.V.T., Ngaoundéré, Cameroun, août 1973.

PRESTON (T.-R.), « Fattening beef cattle on molasses in the tropics », *World Animal Review*, v. 1, pp. 24-29, 1972.

PRESTON (T.-R.), « Rapport de mission sur la perspective de l'embouche bovine à base de mélasses à Mbandjock (Cameroun) », F.A.O., janvier 1973, mimeo.

SERRES, MEISSONNIER et GODET, « Embouche des zébus malgaches, Essais complémentaires », *Rev. Elev. Méd. vét. Pays trop.*, v. 25, n° 4, 1972.

SERRES, GILIBERT, DUBOIS, REVIERS et TARDIF, « Essais d'embouche sur zébus malgaches », *Rev. Elev. Méd. vét. Pays trop.*, v. 24, n° 3, 1971.

SQUIRES (H.-A.), « Intensive Beef Finishing as a possible Technical Innovation in East Africa » East African Agricultural Economics Society Conference, June, 1969.

THORNTON (P.-A.), « An improvement in growth and egg production in chickens fed brewer's dried grains », *Feedstuffs*, v. 34, n° 15, 1962.

VALENZA, CALVET, BOUDERGUES et ORUE, « Essais d'embouche intensive sur Gobra I, 3-5 ans », *Revue Elev. vét. Pays trop.*, v. 24, n° 1, 1971.

VALENZA, CALVET, BOUDERGUES et ORUE, « Essais d'embouche intensive sur Gobra, 2, Mâles castrés, 7-10 ans », *Rev. Elev. Méd. vét. Pays trop.*, v. 24, n° 1, 1971.

VALENZA, CALVET, BOUDERGUES et ORUE, « Essais d'embouche intensive sur Gobra, 3, Mâles entiers 3-5 ans, bœufs 7 - 9 ans », *Rev. Elev. Méd. vét. Pays trop.*, v. 24, n° 4, 1971.

VALENZA, CALVET, ORUE, CHAMBON, « Engraissement intensif de Gobra. 4, Embouche en région rizicole, Mâles entiers ou castrés - poids moyen 250 kg », *Rev. Elev. Méd. vét. Pays trop.*, v. 25, n° 1, 1971.

VALENZA, CALVET, BOUDERGUES et ORUE, « Essais d'embouche intensive sur Gobra I, 3-5 ans », Colloque O.C.A.M., Fort-Lamy, 1969.