THE QUEENSLAND JOURNAL OF
AGRICULTURAL SCIENCE

VOL. 9. - - NO. 3.

SEPTEMBER, 1952.

THE NUTRITIVE VALUE OF SOME QUEENSLAND FODDERS.

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SUMMARY.

The apparent digestibility of a number of Queensland fodders was determined. The nutritive value was assessed directly for both roughages and concentrates, using 2-3-year-old Merino wethers housed in metabolism crates.

Cereal grains and cereal by-products, with the exception of sorghum grain, showed digestibility figures comparable with those recorded by American and British workers. High levels of digestible protein and total digestible nutrients were found for the sorghum grain used in the studies.

Cottonseed meal showed digestibility data comparable with those recorded by overseas workers. Coconut meal was slightly higher in digestibility. The meatmeal used contained 72.5% crude protein, of which 92% was digestible. Mixtures of cereal and protein concentrates gave digestibility figures which were additive.

Lucerne chaff and cereal chaffs yielded data comparable with those recorded for corresponding overseas products. The digestibility data for Mitchell grasses (species of Astrebla) indicated the need for protein and phosphate supplementation to meet the maintenance requirements of sheep and cattle.

Rhodes grass (Chloris gayana) examined at intervals between 5 and 22 months after planting showed a marked fall in both digestible protein and total digestible nutrients. Samples collected 15-22 months after planting made a negative contribution to the animals' protein requirements.

The effect of supplementing poor-quality roughage with protein was examined. For a cereal chaff there was a 5% increase in total digestible nutrients. The apparent digestibility of poor-quality Rhodes grass was not increased by supplementation to give rations containing 5·0% and 6·9% crude protein. At higher levels of supplementation, to give rations of 10·4% and 15.8% crude protein, the digestibility of Rhodes grass was increased by approximately 10%.

The apparent digestibility of the leaves of three edible trees—mulga (Acacia aneura), kurrajong (Brachychiton populneum) and wilga (Geijera parviflora)—was determined. The leaves of the two varieties of mulga examined were low in total digestible nutrients and must be regarded solely as maintenance fodder for sheep. Kurrajong leaves, though higher in total digestible nutrients than mulga leaves, were unexpectedly low in digestible protein and would require supplementation with protein to meet the unspecific maintenance requirements of sheep. Wilga leaves were comparable in food value with good-quality hay.

INTRODUCTION.

During periods of drought in Queensland, many stock-owners endeavour to maintain all or some of their animals by supplementing the inadequate pasture with other feeds. In some districts the main feed becomes the leaves of native fodder trees which are brought by mechanical means within the reach of the sheep or cattle. Some owners use lucerne chaff or a cereal chaff as the basis of drought rations, while others depend on bush hay conserved on the property. In many cases, the basic ingredient in the drought ration is supplemented by cereal grains, cereal by-products, seed-cakes, or compound compressed pellets (" nuts ").

The rations usually recommended have for the most part been formulated on a somewhat empirical basis. For certain fodders, analyses obtained by the conventional proximate-analysis system have been compared with analytical data and digestibility figures obtained for corresponding fodders, and an estimate of the digestibility made. This method is open to question, since fodders grown and prepared under Australian conditions might not have the same digestibility coefficients as their overseas counterparts. In addition, there are some purely local fodders for which no digestibility data were available.

The studies reported here were conducted to ascertain the feeding value of important fodders in terms of digestible protein, total digestible nutrients, metabolizable energy, and starch equivalent. Though the digestibility trials were carried out with sheep, in the light of findings reported in recent literature (Lancaster, 1947 ; Watson *et al.*, 1948; Axelsson, 1949 ; Forbes and Garrigus, 1950) it would appear that they could be extended to cattle, and in the interpretation of the data it has been assumed that the findings are applicable to both sheep and cattle.

The nutritive values were assessed by digestibility trials using 4-6-tooth (2-3- year-old) Merino wethers. All animals were well grown, in strong condition and free from dental defects. Between trials they were allowed an interval of several weeks at pasture supplemented by good-quality lucerne chaff. Their previous history, prior to purchase, was satisfactory. They did not represent the "tail" of a flock culled as "poor doers." This "tail" sometimes represents those sheep which do not exhibit reflex closure of the oesophageal groove during the administration of anthelmintics containing copper sulphate, and which for physiological reasons might return different digestibility data for grain or milled food. Randomised selection of six animals which did not include "poor doers" gave a representative group from which to record the digestibility of the various fodders examined.

The sheep were housed in metabolism crates and fitted with harness to carry faeces bags. The design of the metabolism crate and of the harness and faeces bag has been described elsewhere (Harvey, 1942).

The procedure for each digestion study was as follows :—

(1) All fodder samples were air-dried before feeding ; pasture samples were prepared as chaff ; a representative specimen was taken for analysis at the commencement of the trial.

(2) The animals were allowed a pre-experimental period ranging from 7 to 10 days during which the daily appetite of each sheep for the fodder was assessed ; it was found desirable to maintain each sheep on an intake approximately 2 oz. (50 grams) less than full consumption, as this ensured no feed residues and hence no selectivity by the animals.

(3) The collection period was seven days ; the faeces from each animal were collected in individual containers, dried in a hot-air oven at 105°C. and weighed ; at the conclusion of the collection period the whole of the dried faeces from each animal was finely ground and a representative sample taken for anaylsis.

(4) The percentage of each digestible nutrient in the fodder was calculated from the input of that nutrient in total fodder consumed and its output in the total faeces voided during the 7-day collection period ; the digestibility figures recorded are the mean of the data from six sheep.

The procedure outlined by van Wyk, Oosthuizen and Basson (1951) was used in the calculation of total digestible nutrients (T.D.N.), starch equivalent and metabolizable energy (M.E.) per 100 lb. of dry material.

T.D.N. represents digestible protein + (digestible fat x 2·25) + digestible crude fibre + digestible nitrogen-free extract. Starch equivalent represents (digestible protein x 0·94) + (digestible fat x 1·91) + (digestible crude fibre x 1·0) + (digestible nitrogen-free extract x 1·0).

In the case of fodders with a total crude fibre content of more than 16%, 0·58 lb. of starch equivalent is deducted for every 1% of crude fibre contained in the fodder.

Metabolizable energy is calculated from the following factors :—

Nutrient.	Kind of Fodder.	M.E. per gram. digestible organic material. (calories).
Protein	Roughages	4·3
	Concentrates	4·5
Fat	Roughages	7·8
	Silage	3·3
	Cereals	8·3
	Oil-seeds	8·8
	Of animal origin	9·3
Carbohydrate (nitrogen-free extract) (mean)	All	3·7
Crude fibre	All	2·9

Digestibility values were determined directly for each feedstuff. Even for concentrates it was considered unnecessary to adopt the digestibility-by-difference method, in which the concentrate in question is fed with roughage of known digestibility and the effect of the latter deducted. Investigations of drought-feeding methods had previously shown that grown sheep could be maintained without roughage for periods up to 450 days without any untoward effects. During the studies with concentrates reported here, rumination was suppressed after the first few weeks in the absence of roughage; at the conclusion of the experiment normal rumination was induced within 10 days by carefully introducing roughage into the diet.

RESULTS.

Cereal Grains and Cereal By-products.

The data obtained for various cereal grains and cereal by-products are given in Tables 1-3.

Table 1.

Composition of Cereal Grains and Cereal By-products on a Moisture-free Basis.

Feed.	Crude protein.	Fat.	Crude fibre.	Ash.	N.F.E.	Lime (CaO).	Phosphoric acid (P_2O_5).
	%	%	%	%	%	%	%
Maize	11·0	5·1	4·3	1·5	78·1	0·001	0·840
Wheat	16·4	1·9	3·3	1·9	76·5	0·032	0·914
Sorghum	13·3	2·5	3·2	1·4	79·6	0·060	0·717
Bran	19·6	3·9	10·4	5·9	60·2	..	..
Pollard	19·2	4·4	7·0	4·3	65·1	0·076	1·74
Rice pollard	12·6	16·3	13·5	11·6	46·0	0·007	3·33

Table 2.

DIGESTIBILITY OF CEREAL GRAINS AND CEREAL BY-PRODUCTS.

Feed.	Dry material.	Crude protein.	Fat.	Fibre.	N.F.E.
	%	%	%	%	%
Maize ..	89·7	83·1	93·7	46·9	95·5
Wheat ..	88·1	89·6	82·8	23·0	93·0
Sorghum ..	92·2	78·8	73·8	73·6	96·1
Bran ..	68·5	84·2	86·5	28·2	74·9
Pollard ..	79·7	86·3	87·6	23·7	86·6
Rice pollard	73·9	70·6	94·1	43·5	84·2

Table 3.

DIGESTIBLE PROTEIN, TOTAL DIGESTIBLE NUTRIENTS, METABOLIZABLE ENERGY, AND STARCH EQUIVALENT PER 100 LB. OF DRY (MOISTURE-FREE) MATERIAL OF CEREAL GRAINS AND CEREAL BY-PRODUCTS.

Feed.	Digestible protein.	T.D.N.	M.E.	Starch equivalent.
	Lb.	Lb.	Therms.	Lb.
Maize	9·1	96·5	164·5	94·4
Wheat	14·4	89·7	155·4	89·3
Sorghum	10·5	93·4	159·8	92·2
Bran	16·5	72·0	126·0	69·9
Pollard	16·6	83·5	145·4	81·1
Rice pollard ..	8·9	87·9	148·3	82·2

The data recorded have been compared with those published by British and American workers (Wood, 1932; Morrison, 1938) and with the data on the digestibility of various feeds throughout the world compiled by Schneider (1947). The results of these comparisons may be summarised as follows :—

(1) *Maize.*—The values are comparable with those found by all workers using a product of similar quality.

(2) *Wheat.*—As for maize.

(3) *Sorghum.*—Both protein content and total digestible nutrients are higher than those recorded in the literature.

(4) *Bran and Pollard.*—The digestibility values are intermediate between those recorded by American and British workers, respectively.

(5) *Rice pollard.*—The level of total digestible nutrients is higher than that recorded in the literature.

Protein Concentrates.

Values for the various protein concentrates examined are recorded in Tables 4-6.

Table 4.

COMPOSITION OF PROTEIN CONCENTRATES ON A MOISTURE-FREE BASIS.

Feed.	Crude protein.	Fat.	Crude fibre.	Ash.	N.F.E.	Lime (CaO)	Phosphoric acid (P_2O_5).
	%	%	%	%	%	%	%
Cottonseed meal	47·1	7·3	11·2	6·1	28·3	0·205	2·48
Coconut meal	22·6	8·2	14·0	5·7	49·5	0·10	1·31
Meatmeal	72·5	9·0	..	18·5	..	4·32	4·38
Cottonseed meal + maize meal (ratio 1 : 14).. ..	13·9	4·0	3·5	1·7	76·9	..	..
Coconut meal + maize meal (ratio 1 : 8)	12·7	4·1	4·3	1·9	77·0	..	..

Table 5.

DIGESTIBILITY OF PROTEIN CONCENTRATES.

Feed.	Dry material.	Crude protein.	Fat.	Fibre.	N.F.E.
	%	%	%	%	%
Cottonseed meal ..	72·7	84·6	91·0	43·0	66·0
Coconut meal	82·9	82·4	96·7	78·8	84·3
Meatmeal	81·5	92·0	98·1	..	..
Cottonseed meal + maize meal (ratio 1 : 14) ..	89·3	82·6	89·4	42·9	94·5
Coconut meal + maize meal (ratic 1 : 8) ..	88·2	78·9	89·7	49·6	94·3

Table 6.

DIGESTIBLE PROTEIN, TOTAL DIGESTIBLE NUTRIENTS, METABOLIZABLE ENERGY, AND STARCH EQUIVALENT PER 100 LB. OF DRY (MOISTURE-FREE) MATERIAL OF PROTEIN CONCENTRATES.

Feed.	Digestible protein.	T.D.N.	M.E.	Starch equivalent.
	Lb.	Lb.	Therms.	Lb.
Cottonseed meal	39·8	78·2	145·0	73·5
Coconut meal	18·6	89·1	152·5	85·3
Meatmeal	66·7	86·5	173·2	79·5
Cottonseed meal + maize meal (ratio 1 : 14)	11·3 (calculated)	93·9	161·2	92·0
	11·7 (found)	93·8	161·0	91·9
Coconut meal + maize meal (ratio 1 : 8)	10·6 (calculated)	92·9	159·4	92·0
	10·0 (found)	93·1	159·3	91·3

These findings have been compared with the data recorded by overseas workers. The results may be summarised as follows :—

(1) *Cottonseed meal.*—The findings are comparable with those of overseas workers using a product of similar quality.

(2) *Coconut meal.*—Digestibility is slightly higher than that recorded in the literature.

(3) *Meatmeal.*—The protein of the exceedingly rich product used is almost entirely digestible.

(4) The digestibility trials using mixed products of cottonseed and maize meal, and coconut and maize meal, show that at the ratios fed the digestibility figures are additive.

Roughages.

The data obtained for various roughages examined are recorded in Tables 7-9.

Table 7.

COMPOSITION OF DRY ROUGHAGES ON A MOISTURE-FREE BASIS.

Feed.	Crude protein.	Fat.	Crude fibre.	Ash.	N.F.E.	Lime (CaO).	Phosphoric acid (P_2O_5).
	%	%	%	%	%	%	%
Lucerne chaff	20·4	1·9	17·4	14·6	45·7	..	..
Oaten chaff	6·2	3·3	29·9	6·1	54·5	0·176	0·199
Wheaten chaff	9·8	2·1	24·9	8·1	55·1	0·72	0·216
Mitchell grass (1)	4·4	1·2	36·5	11·7	46·2	0·470	0·116
,, ,, (2)	5·1	1·1	34·8	9·6	49·4	0·212	0·145
,, ,, (3)	5·6	1·2	35·8	11·9	45·5	0·60	0·160
,, ,, (4)	8·1	1·0	37·1	9·6	44·2	0·314	0·301
Rhodes grass (A)	6·0	0·9	36·0	8·7	48·4	..	..
,, ,, (B)	6·1	0·9	35·4	9·6	48·0	..	..
,, ,, (1)	11·1	1·1	39·8	10·9	37·1	0·490	0·60
,, ,, (2)	6·9	1·4	39·4	10·9	41·4	0·609	0·642
,, ,, (3)	8·2	1·1	37·4	10·7	42·6	0·565	0·838
,, ,, (4)	5·9	1·1	34·9	10·6	47·5	0·421	0·674
,, ,, (5)	7·0	1·2	34·3	11·5	46·0	0·570	0·640
,, ,, (6)	6·5	1·1	34·4	10·4	47·6	0·490	0·450
,, ,, (7)	3·1	0·9	34·7	13·1	48·2	0·556	0·443
,, ,, (8)	3·5	0·9	32·0	10·5	53·1	0·409	0·527
,, ,, (9)	2·4	0·9	35·9	11·3	49·5	0·443	0·455
,, ,, (10)	2·8	0·7	38·8	9·5	48·2	0·574	0·319
,, ,, (11)	2·8	0·7	35·4	11·0	50·1	0·489	0·464
Oaten chaff + cottonseed meal (ratio 3 : 1)	17·2	4·5	24·9	6·2	47·2	..	..
Oaten chaff + meatmeal (ratio 6 : 1)	15·3	4·1	25·6	8·3	46·7	..	..
Rhodes grass (11) + cottonseed meal (ratio 20 : 1) ..	5·0	1·0	34·3	10·8	48·9	..	..
Ditto (ratio 10 : 1)..	6·9	1·2	33·2	10·8	47·9	..	..
Ditto (ratio 5 : 1)..	10·4	1·8	31·5	10·3	46·0	..	..
Ditto (ratio 5 : 2)..	15·8	2·5	28·7	9·8	43·2	..	..

Table 8.

DIGESTIBILITY OF DRY ROUGHAGES.

Feed.	Dry material.	Crude protein.	Fat.	Fibre.	N.F.E.
	%	%	%	%	%
Lucerne chaff	62·2	77·0	62·3	27·9	79·4
Oaten chaff	54·2	50·4	65·0	44·6	62·7
Wheaten chaff	58·6	58·9	51·3	53·1	65·9
Mitchell grass (1)	40·5	4·5	21·3	52·7	42·1
,, ,, (2)	37·6	26·7	45·4	46·8	37·5
,, ,, (3)	46·0	39·0	56·0	54·0	57·0
,, ,, (4)	50·4	56·5	46·1	61·2	46·2
Rhodes grass (A)	46·8	42·7	25·3	52·6	46·7
,, ,, (B)	44·2	41·0	11·5	48·5	44·2
,, ,, (1)	55·3	66·4	48·7	62·5	48·0
,, ,, (2)	45·6	44·7	46·8	52·1	43·3
,, ,, (3)	45·7	46·4	35·2	56·6	44·4
,, ,, (4)	41·0	23·1	33·6	52·8	43·0
,, ,, (5)	55·3	52·3	45·9	64·4	54·5
,, ,, (6)	42·5	42·5	48·7	49·7	43·9
,, ,, (7)	46·9	−ve	37·4	58·9	47·1
,, ,, (8)	46·6	5·8	29·5	53·5	52·7
,, ,, (9)	32·4	−ve	21·9	49·0	32·9
,, ,, (10)	32·0	−ve	7·7	46·5	30·8
,, ,, (11)	37·8	−ve	33·5	53·1	40·0
Oaten chaff + cottonseed meal (ratio 3 : 1)	62·0	75·5	84·1	51·5	65·5
Oaten chaff + meatmeal (ratio 6 : 1)	62·2	77·5	85·5	53·1	66·0
Rhodes grass (11) + cottonseed meal (ratio 20 : 1)	40·0	22·4	66·4	54·2	41·8
Ditto (ratio 10 : 1)	37·7	42·0	57·0	46·1	41·7
Ditto (ratio 5 : 1)	50·4	64·9	87·2	56·0	47·9
Ditto (ratio 5 : 2)	55·0	75·1	87·8	57·1	53·1

Table 9.

DIGESTIBLE PROTEIN, TOTAL DIGESTIBLE NUTRIENTS, METABOLIZABLE ENERGY AND STARCH EQUIVALENT PER 100 LB. OF MOISTURE-FREE MATERIAL OF DRY ROUGHAGES.

Feed.	Digestible protein.	T.D.N.	M.E.	Starch equivalent.
	Lb.	Lb.	Therms.	Lb.
Lucerne chaff	15·7	59·6	102·2	48·2
Oaten chaff	3·4	55·5	89·0	37·4
Wheaten chaff	5·8	57·8	93·5	42·6
Mitchell grass(1)	0·2	39·6	59·5	18·2
,, ,, (2)	1·4	37·2	57·0	16·8
,, ,, (3)	2·2	48·5	74·9	27·1
,, ,, (4)	4·6	48·8	74·8	26·9
Rhodes grass (A)	2·6	44·6	68·6	23·5
,, ,, (B)	2·5	41·1	63·5	20·5
,, ,, (1)	7·4	51·2	78·8	28·0
,, ,, (2)	3·1	43·1	64·8	20·0
,, ,, (3)	3·8	44·8	68·0	22·8
,, ,, (4)	1·4	41·1	62·2	20·7
,, ,, (5)	3·7	51·6	79·7	31·6
,, ,, (6)	2·8	42·0	64·8	21·8
,, ,, (7)	−ve	43·8	66·0	23·6
,, ,, (8)	0·2	45·9	70·5	27·3
,, ,, (9)	−ve	34·3	51·2	13·5
,, ,, (10)	−ve	32·8	48·9	10·3
,, ,, (11)	−ve	39·2	59·0	18·5
Oaten chaff + cottonseed meal (ratio 3 : 1)	13·0 (calculated)	62·0	103·2	46·8
	13·0 (found)	65·2	108·9	48·8
Oaten chaff + meatmeal (ratio 6 : 1)	12·2 (calculated)	60·9	101·0	43·5
	11·9 (found)	64·2	107·6	47·5
Rhodes grass (11) + cottonseed meal (ratio 20 : 1) ..	1·9 (calculated)	41·2	63·0	21·0
	1·1 (found)	41·7	63·1	21·9
Ditto (ratio 10 : 1) ..	3·6 (calculated)	42·7	66·2	23·4
	3·0 (found)	40·3	62·3	20·8
Ditto (ratio 5 : 1) ..	6·9 (calculated)	45·5	73·5	27·4
	6·7 (found)	50·1	79·4	30·6
Ditto (ratio 5 : 2) ..	11·7 (calculated)	50·3	82·4	34·1
	11·9 (found)	56·1	91·8	38·1

The following comments are made on the results.

(1) *Lucerne.*—The lucerne used in this trial was choice-quality leafy chaff. The digestibility data obtained are comparable with those recorded by overseas workers using lucerne of similar quality.

(2) *Cereal Chaffs.*—The oaten chaff and the wheaten chaff represented products of average quality and the digestibility data compare with those found by overseas workers.

The effect of protein supplementation on the digestibility of oaten chaff was also examined. Two sources of protein supplements were used—a vegetable-protein meal (cottonseed meal) and an animal-protein meal (meatmeal). The ratio of each supplement to the basal oaten chaff was adjusted to give a ration comparable with good-quality lucerne chaff. At the rate of supplementation and for both types of protein meal used in these studies, two conclusions were drawn :—

(*a*) There is no increase in the digestibility of the protein from oaten chaff. It was found that the digestible protein from each of these rations approximates very closely to the sum of the digestible protein from oaten chaff and the digestible protein from cottonseed meal or meatmeal as determined by individual digestion trials.

(*b*) There is an increase of approximately 5% in the total digestible nutrients of the ration as compared with the total digestible nutrients from individual trials on oaten chaff and each of the protein supplements, indicating that protein supplementation enables the animal to make better use of the basal ration of oaten chaff.

(3) *Mitchell Grass.*—The digestibility data were determined for four samples of Mitchell grass taken from stocks of baled Mitchell grass hay, chiefly *Astrebla lappacea,* conserved on four sheep properties in western Queensland and set aside as a fodder reserve for times of drought. The procedure adopted in the conservation of Sample 3 has been discussed elsewhere (Marriott and Harvey, 1951). The following conclusions may be drawn from these studies :—

(*a*) The digestibility of Mitchell grass is very closely related to the crude protein content.

(*b*) Sample 1, which contained 4·4% crude protein, has virtually no digestible protein, and total digestible nutrients are equivalent to those recorded for oaten straw.

(*c*) Samples 3 and 4 are more nearly comparable with fair-quality oaten hay.

(*d*) Samples 1, 2, and 3 would require protein supplementation to meet the maintenance protein requirements of sheep and cattle.

(*e*) The level of phosphoric acid in all samples is closely related to the protein content. Samples 1, 2 and 3 would require a phosphate supplement to meet the maintenance phosphate requirements of cattle.

(4) *Rhodes Grass.*—The following field information must be considered in conjunction with the digestibility data for Rhodes grass (*Chloris gayana*) recorded in Tables 7-9 and Fig. 1 :—

(*a*) All samples were taken between 1937 and 1939 at the Callide Cotton Research Station (now Biloela Regional Experiment Station).

(*b*) All samples were grown on soil high in nitrogen following continuous cotton cultivation for three years.

(*c*) Samples A and B were taken in September and October 1937 and represent Rhodes grass in the first year of growth.

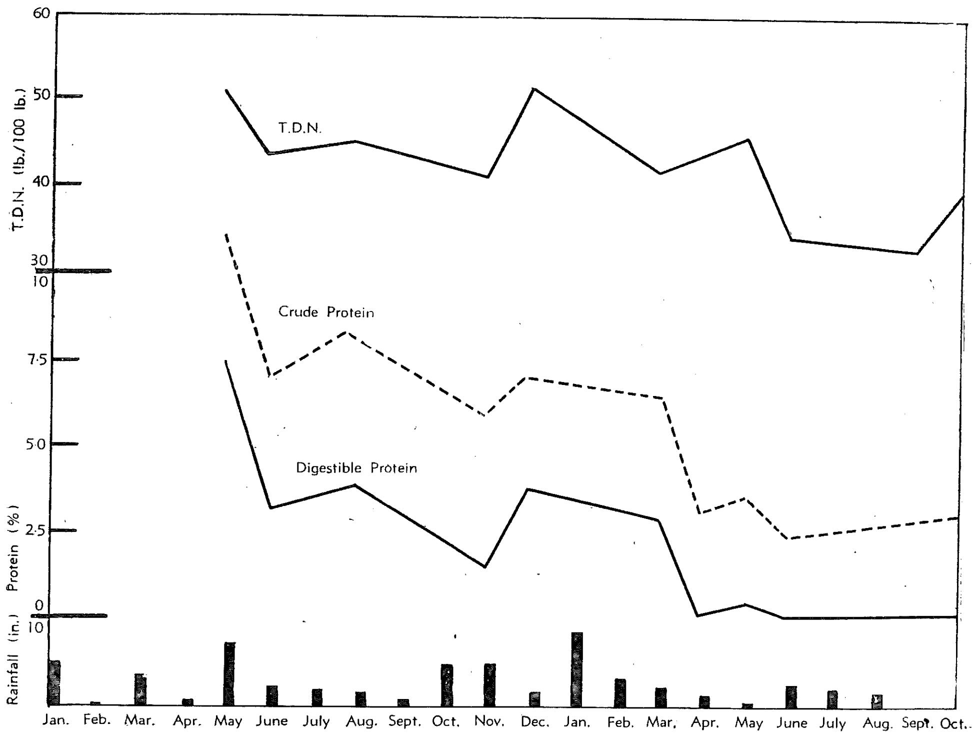

Fig. 1.

Graph Showing the Variation in the Nutritive Value of Rhodes Grass with Age of the Stand. The block was sown on December 7, 1937, and sampling began in May 1938.

(*d*) Samples 1-11 were taken from an area planted to Rhodes grass on 7–12–37 after three years of cotton. There was ample subsoil moisture at the time of planting, and the monthly rainfalls during the collection period were as follows :—

Month.	Rainfall.	Comments.
1938.	in.	
January	4·60	Slightly above normal
February	0·05	Dry
March	3·40	Above normal
April	0·67	Below normal
May	7·00	Above normal
June	1·79	Slightly below normal
July	1·79	Slightly above normal
August	1·45	Above normal
September	0·42	Below normal
October	4·22	Above normal
November	4·40	Above normal
December	1·48	Below normal
1939.		
January	8·07	Above normal
February	2·70	Below normal
March	1·78	Below normal
April	1·30	Below normal
May	0·12	Below normal
June	2·08	Normal
July	1·50	Slightly below normal
August	1·25	Slightly below normal

The periods at which the samples were collected and the time intervals since the planting of this area to Rhodes grass in December 1937 are as follows :—

Sample No.	Month of Collection.	Period Since Planting.
	1938.	Months.
1	May	5
2	June	6
3	August	8
4	November	11
5	December	12
	1939.	
6	March	15
7	April	16
8	May	17
9	June	18
10	September	21
11	October	22

The following conclusions may be drawn from examination of both field and digestibility data :—

(*a*) Sample 1 is high in digestible protein, being intermediate in value between oaten chaff and fair-quality lucerne chaff; the total digestible nutrients are comparable with those recorded for oaten chaff.

(*b*) The remaining samples show a marked fall in protein content with a corresponding reduction in total digestible nutrients. This is shown graphically in Fig. 1.

(*c*) For Samples 2-6, harvested 6-15 months after planting, the feeding value remained relatively constant. The digestible protein content of these samples approximates that of oaten chaff, but the total digestible nutrients and starch equivalent are much lower.

(*d*) Samples 7-11, collected 15-22 months after planting, show a marked deterioration in protein content; the protein level has made a negative contribution to the animals' economy. The deterioration in protein is most marked in Samples 9 and 11, the feeding value of which is below that of oaten straw.

(*e*) All samples taken after 15 months' growth would require a protein supplement to meet the animals' maintenance requirements. Such supplementation was examined, using cottonseed meal at various levels as a supplement to Rhodes grass (Sample 11). Two important features are shown by these supplementation trials, viz. :—

(i) Cottonseed supplementation of poor-quality Rhodes grass at ratios of 20 : 1 and 10 : 1, to give rations of crude protein content of 5·0% and 6·9% respectively, does not increase the digestibility of the basal Rhodes grass. The apparent digestible protein content of the two rations is lower than that calculated from individual digestibility trials on Rhodes grass and cottonseed meal. This is no doubt due to the method of calculation, in which the negative digestible protein content of the Rhodes grass has been considered as zero.

(ii) Cottonseed supplementation of poor-quality Rhodes grass at ratios of 5 : 1 and 5 : 2, to give rations with crude protein contents of 10·4% and 15·8% respectively, increased the digestibility of the basal Rhodes grass by approximately 10%.

(*f*) The levels of phosphoric acid recorded in samples of Rhodes grass used in these trials all exceed the maintenance requirements of stock. This is not necessarily true for Rhodes grass grown under different conditions.

Leaves of Edible Trees.

Digestibility trials were conducted with the leaves of four of the most common fodder trees found in the arid and semi-arid pastoral areas of Queensland. The results are recorded in Tables 10-12.

Table 10.

COMPOSITION OF LEAVES OF EDIBLE TREES ON A MOISTURE-FREE BASIS.

Fodder.	Crude protein.	Fat.	Crude fibre.	Ash.	N.F.E.	Lime (CaO).	Phosphoric acid (P_2O_5).
	%	%	%	%	%	%	%
Umbrella mulga (*Acacia aneura*)	12·8	1·1	32·9	6·0	47·2	1·50	0·15
Whipstick mulga (*Acacia aneura*)	13·4	2·2	27·9	5·0	51·5	..	..
Kurrajong (*Brachychiton populneum*)	9·6	3·9	29·6	5·7	51·2	2·03	0·37
Wilga (*Geijera parviflora*) ..	14·2	7·0	19·0	11·6	48·2	5·03	0·51

Table 11.

DIGESTIBILITY OF LEAVES OF EDIBLE TREES.

Fodder.	Dry material.	Crude protein.	Fat.	Fibre.	N.F.E.
	%	%	%	%	%
Umbrella mulga ..	36·7	27·3	−ve	29·8	53·1
Whipstick mulga ..	37·4	33·6	−ve	21·9	54·0
Kurrajong	52·1	15·6	43·6	35·1	69·9
Wilga	46·8	45·0	55·7	54·7	58·1

Table 12.

DIGESTIBLE PROTEIN, TOTAL DIGESTIBLE NUTRIENTS, METABOLIZABLE ENERGY, AND STARCH EQUIVALENT PER 100 LB. OF MOISTURE-FREE MATERIAL OF LEAVES OF EDIBLE TREES.

Fodder.	Digestible protein.	T.D.N.	M.E.	Starch equivalent.
	Lb.	Lb.	Therms.	Lb.
Umbrella mulga ..	3·5	38·4	62·3	19·3
Whipstick mulga ..	4·5	38·4	63·5	21·9
Kurrajong	1·5	51·5	82·8	33·6
Wilga	6·4	53·6	87·0	40·8

Following is a summary of the results :—

(1) *Mulga.*—Both varieties are readily eaten by sheep but are low in total digestible nutrients. This is unexpected in view of the composition on a moisture-free basis, which would indicate a fodder intermediate between good-quality oaten chaff and fair-quality lucerne chaff. The percentage of dry material digested is low, being comparable with that recorded for Mitchell grass hay of low protein content and Rhodes grass hay cut late in the second year of growth. The percentage of protein digested is low compared with other fodders, but because of the relatively high crude protein content, this digestible protein level would still meet the unspecific

maintenance requirements of sheep. The total digestible nutrients, metabolizable energy and starch equivalent values all indicate that the leaves of mulga must be regarded as a fodder for maintenance rather than for production. This is in keeping with the views of some experienced pastoralists, who regard mulga leaves as a good drought-feed reserve for mature sheep, but one on which it is not possible either to maintain pregnant ewes or to raise satisfactory lambs (Everist, 1949 ; M. White, personal communication, 1951).

The ash analysis indicates a low level of phosphoric acid superimposed on a very wide calcium-to-phosphorus ratio. The phosphoric acid content of mulga leaves would not be expected to meet the maintenance requirements of even mature stock held on this diet for long periods.

(2) *Kurrajong.*—This fodder was not so well eaten as mulga during the course of the digestibility trial. All animals showed a tendency to " scour " during their third week on this diet. The percentage of dry material digested is much higher than that of mulga and is comparable with that recorded for fair-quality oaten chaff. The percentage of the crude protein which was digested is unexpectedly low, even in comparison with mulga leaves. The digestible protein content of kurrajong is similar to that recorded for Mitchell grass hay of low protein content and would not meet the maintenance requirements of mature sheep. The total digestible nutrients, metabolizable energy and starch equivalent values compare with those found for fair-quality oaten chaff. The ash analysis indicates that kurrajong leaves are high in lime and fair in phosphoric acid. The Ca : P ratio is wide. Where kurrajong is the sole source of fodder for sheep, some protein supplementation would be necessary.

(3) *Wilga.*—The leaves of this tree were very readily eaten and well digested by sheep. The digestible protein content is intermediate between those recorded for good-quality oaten chaff and fair-quality lucerne chaff respectively. The total digestible nutrients, metabolizable energy and starch equivalent values all indicate a fodder comparable with good-quality hay. The ash analysis shows a very high lime content and a very wide Ca : P ratio. The phosphoric acid level should be adequate for stock.

ACKNOWLEDGMENTS.

The author wishes to acknowledge his indebtedness to Dr. John Legg (Director of Research in the Division of Animal Industry) for providing facilities and to Dr. M. White (Agricultural Chemist and Biochemist) for permission to publish these findings, some of which formed part of a programme of drought-feeding studies initiated at his direction.

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