EVALUATION OF THE FEEDING VALUE OF TEA WASTE FOR MILK PRODUCTION IN COWS

BY

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "EVALUATION OF THE FEEDING VALUE OF TEA WASTE FOR MILK PRODUCTION IN COWS" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

V. PRASAD.

Mannuthy,

29-7-1978.

CERTIFICATE

Certified that this thesis entitled "EVALUATION OF THE FEEDING VALUE OF TEA WASTE FOR MILK PRODUCTION IN COWS" is a record of research work done independently by Sri. V. Prasad under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to him.

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C O N T E N T S

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INTRODUCTION

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Dairying in India is basically a rural agricultural enterprise of the millions of small farmers in the country. An appreciable portion of the total income of our people is derived directly or indirectly from livestock and livestock products. According to the national income statistics issued by Central Statistical Organisation, the gross contribution from animal husbandry sectors was estimated to be Rs.3000/- crores during 1966-67 (Dharmendrakumar, 1977).

According to the livestock census 1972, the total livestock population in India was enumerated to be 354.98 million comprising of 178.97 million cattle, 57.94 million buffaloes, 40.39 million sheep, 68.02 million goats and 9.76 million other livestock, besides 136.77 million poultry. Thus at present the livestock population including poultry is about 90 per cent of the human population (Dharmendrakumar, 1977).

The average annual milk production per cow in our country is very low (175 kg) as compared to that of Australia (5000 kg), the United States of America (4154 kg), the United Soviet Socialist Republic (4000 kg), the United Kingdom (3950 kg), Denmark (3905 kg), Switzerland (3650 kg) and

Newzealand (2794 kg). As a consequence to this the per capita availability of milk in India is estimated to be about 110 g per day as against 284 g recommended by the Nutritional Advisory Committee (Patel, 1976).

Kerala has 2.86 million cattle and 0.47 million buffaloes. The total milk production in the State during 1973-74 was estimated as 0.44 million tonnes with an average per capita availability of 50.3 g (Nagarcenkar, 1977). At present the availability of milk is just enough to cater to the needs of 25 per cent of the people in Kerala. This indicates that the milk production of the State has to be increased by four to five times to reach a reasonable level of consumption (Nagarcenkar, 1977).

The cows and she-buffaloes are the vital sources of milk needed by millions of undernourished people and they form 38 per cent of the world livestock population (FAO,1969). Of the total population of cows and buffaloes in the country about nine million are either unproductive or uneconomic. It is generally agreed that one of the main factors responsible for the low productivity and poor conditions of the animals in the country is severe undernourishment due to the acute shortage of both roughage and concentrates (Kehar, 1953; Sen, 1953; Khurody, 1974).

If a significant increase in milk production is to be achieved, additional feed has to be made available or a greater percentage of the available feed has to be reserved for high yielding animals (Nair and Balakrishnan, 1973 and Patel, 1976). The demand for cereal grains as human food and the favourable export position of oil seeds and oil cakes preclude any significant increase in the supply of concentrate feed for livestock. The present level of milk production in the country could be maintained by a comparatively smaller number of animals provided adequate feeds and fodders are ensured (Report of National Commission on Agriculture, 1976). The available experimental evidence shows that better feeding alone can increase the average yield of animals by 50 per cent or more (Singh, 1975).

Most of the milk production in India is from animals fed with straws and hays and a little rough grazing, plus an amount of concentrates (Whyte and Mathur, 1968). India is short to the extent of 40 per cent in roughages and 70 per cent in concentrates to meet the livestock needs (Venkatachar, 1976). A detailed analytical approach reveals that feed alone accounts for 60-70 per cent of the total cost of milk production in our country as against 45-60 per cent in Western countries with a developed dairy industry. This, therefore, highlights the need for supply of nutrients required for milk production as cheap as possible (Patel, 1976). All attempts

to raise the nutritional status of livestock have thus been stifled with the quantitative inadequacy of feeds and fodders and their qualitative insufficiency. There is, therefore, an imperative need to explore the possibility of mitigating the existing deficiency by utilising unconventional feeds and agricultural and industrial by-products which go as wastes. The limitations in using these materials, however, are that they should be available in plenty, nutritious, palatable and could be processed if it becomes so necessary. Extensive investigations, mostly under the auspices of the Indian Council of Agricultural Research have been carried out in this regard by several authors for different species of animals. The research work already carried out has shown that various items like tapioca leaves, tapioca starch waste, silk worm pupae etc., can be successfully used in the feeding of livestock (ICAR Hand Book, 1971).

It has been reported that about 80 per cent of the available source of cattle feed is from agro-industrial by-products and the rest from cultivated fodder (Ulhas, 1976). Among the various unconventional feeds that can be used for feeding livestock, teawaste has gained importance.

In South India the cultivation of tea commenced towards the middle of the last century only and was initially on small scattered individual holdings. Between 1927 and 1932 the area under tea in South India increased from 34,000 to 48,000 hect.

and at present the figure is just over 74,000 hectares. The industry provides directly or indirectly livelihood for about 20 lakh persons. The production of tea in South India, roughly estimated as 1600 kg/hectare, is the highest of any major tea growing region in the world (Ram, 1978).

Tea plant is botanically classified as Camellia sinensis Linn. (Encyclopaedia Britanica, 1957). It is a hybrid of three distinct species. The commercially cultivated tea plant in South India is a Assam-China hybrid with a medium size dark leaf (Ram, 1978). The manufacture of tea as it is practised today, is a specialised operation involving application of modern methods of biochemical engineering. The freshly harvested tea shoots can be processed into various kinds of tea, namely black tea, green tea, instant tea. In the manufacture of black tea the material undergoes fermentation, while in the production of green tea, fermentation is purposely eliminated. Instant tea is a dehydrated product which contains all the soluble constituents of tea, but from which the insoluble proteins have been removed. Manufacture of instant tea basically involves extraction of water soluble constituents of the fresh tea leaf or the fermented leaf mass followed by drying of the clarified extract in a spray dryer, drum dryer or a freeze dryer (Mitra, 1978).

Tea waste is a by-product obtained after the extraction

of tea leaves during the process of instant tea manufacture. Teawaste has been found to be a good source of crude protein and calcium. It contains only a small proportion of tannins. The percentage of fibre is higher as compared to other protein rich concentrates (Ananthasubramaniam and Maggie Menachery, 1977). It has been reported that about ten million kg of teawaste is available in the country (Vimal, 1976).

The purpose of the present investigation was to find out the feeding value of teawaste for milk production in cows so that it can be incorporated successfully and economically in the rations of dairy cows. An attempt has also been made to study the effect of feeding teawaste on butter fat.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Large quantities of agricultural and industrial residues with low feed values exist in the world. At present most of these materials not only are wasted but also form important sources of environmental pollution. Those residues high in cellulose and hemicellulose are potentially valuable sources of energy to ruminant animals.

Because of the unique but precious ability of the ruminants to utilize cellulose and the increasing public sentiment towards recycling, dairy cattle are being used to recycle many substances which go as waste to be utilized as feeds for milk production in order to meet the increasing demand for food by ever expanding human population. These include dehydrated poultry waste, other animal wastes, waste papers and some of the agricultural and industrial by-products (Campbell and Marshall, 1975).

The teawaste possesses a digestible crude protein of 9.7 per cent and total digestible nutrient of 43.0 per cent. The total tannins present in the material is only 1.9 per cent. Results from the feeding trials indicated that teawaste can form a potential feed source for livestock. The material has been found to be fairly palatable to cattle in as much as the animals consumed the material upto 1.5 kg/day (Ananthasubramonian and Maggie Menachery, 1977). On a general analysis Indian tea

has been found to be contain 22.60 to 25.5 per cent protein, 4.67 to 4.90 per cent sugar, 3.06 to 3.51 per cent caffeine and 5.39 to 6.07 per cent ash (Mitra, 1978).

According to Natarajan et al. (1959) tea contains four per cent nitrogen. The amount of crude protein was found to vary widely but in manufactured tea a value of 23 per cent of dry weight has been reported.

The carbohydrate content of unprocessed Assam tea has been reported as 31 per cent (dry weight), mostly contributed by crude fibre with sugars, starch, pectins and pentosans. Only four to five per cent of the solids are extracted by hot water, allowing tea to be used in low-caloric diets of human beings (Mitra, 1978).

The tannin content of teawaste has been found to be 1.9 per cent (Ananthasubramaniam and Maggie Menachery, 1977). According to Kursanov et al. (1947) major portion of tannins in tea dust is extractable with water. Tannins generally bring about reduction in feed intake and digestibility of proteins. In ruminants they affect microbial protein synthesis. In sal-seed meal the tannin content has been found to vary from 3.5 to 13.33 per cent (Arora et al., 1978). McLeod (1974) found that there was a depression in the digestibility of nutrients and development of toxic symptoms associated with inclusion of sal-seed meal in animal diet. He attributed it

to the higher content of tannins in the sal-seed meal.

Kaplan et al. (1974) found that tea leaves contained caffeine from 2.7 to 4.0 per cent with an average of 3.3 per cent. Raquibuddowla et al. (1969) studied an extraction of caffeine from teawaste. The pure caffeine obtained melted between 236°C and 238°C and the yield of caffeine was found to be more than 70 per cent based on caffeine content of the waste.

The effect of tea on iron absorption was studied by Disler et al. (1975) in human beings and they found that absorption of iron was inhibited by tea. The effect was attributed to the formation of insoluble iron tannate complexes; It was suggested that tannin containing beverages such as tea may contribute to the pathogenesis of iron deficiency if the diet consists largely of foods of plant origin.

Co and Sanderson (1970) conducted an experiment in which ^{14}C amino acids were added to fresh tea leaf homogenate undergoing conversion to black tea. After conversion the volatile compounds present in the head space over the reaction mixture were collected and analysed by gas chromatography. Results showed that leucine, isoleucine, valine and phenyl alanine were partially converted to the aldehydes. These aldehydes were constituents of black tea aroma. Further,

drying of the fermented mixture caused an additional amount of the aldehydes to be formed. In contrast, no detectable volatile compounds were formed from aspartic glutamic acid, glutamine, arginine etc. Tea leaf which had been inactivated by steam treatment was not effective in causing formation of volatile aldehydes from the amino acids.

√ Patel et al. (1971) conducted an experiment with two matched groups of six lactating Kankrej cows which received (i) a conventional concentrate mixture or (ii) a mixture of 75 per cent conventional mixture and 25 per cent of a mixture of seed of sickle senna (Cassia tora L.), mango seed kernels and tomato waste. All animals received a basic feed of five kg lucerne and churodi hay ad lib. From the experiment it was concluded that 25 per cent of the conventional concentrate can be safely replaced by these products in rations for dairy cows without affecting the yield and fat percentage.

Weight by weight substitution of guar-meal (Cyamopsis psoralioides) for groundnut cake in the concentrate mixture of six lactating Sahiwal cows did not significantly affect the milk yield. There was no change in the flavour of the milk from cows fed with the guar-meal mixture (Thatte et al., 1967).

An experiment was conducted by Macgregor et al. (1976) to find out the effect of increasing the fibre content in the

ration with soybean will run on digestibility and lactation performance. Soybean mill run was used as replacement of the corn grain in the concentrate mixture in such a way as to get the crude fibre content in the complete ration as 13, 18 and 23 per cent. The treatments did not significantly affect the drymatter intake, digestible drymatter intake, production of four per cent fat corrected milk, milk fat test (4.1 average) drymatter digestibility and rumen volatile fatty acids. When soybean mill run was used for replacing 53.71 per cent of the corn in the concentrate mixture no adverse effect on lactation performance and health status was noticed.

Ralo et al. (1964) replaced palm kernel meal (25% of concentrates) by dried tomato pressings in the rations of dairy cows and found that there was no significant effect on either milk yield or composition. Patel et al. (1971) noticed that by incorporating tomato waste at 16 per cent level in the rations of Kankrej milch cows there was no adverse effect on the milk yield and fat corrected milk yield. A trend for higher fat percentage was noted in the milk of cows that received tomato waste in their ration.

Nicholson and Curtis (1960) conducted a feeding trial in which grass silage was partly or completely replaced by pulped potato to provide an equivalent amount of drymatter.

A significant increase in fat content was noticed when grass silage was completely replaced by potatoes. When the protein content in the ration was increased to 15-20 per cent an increase in the fat corrected milk and solids-not-fat yield was noticed. Cows on the high protein-potato ration maintained body weight while greatest losses were found in the unreplaced ration.

Bugdol et al. (1968) found that the potato haulm silage was on starch equivalent basis, having the same feed value as sugar beet top silage and grass silage. From the experiment he concluded that potato haulm silage can be safely fed to cows in quantities not exceeding 20 kg per cow per day.

The utilization of wet potato pulp and dried beet pulp as dairy cattle feed was conducted by Hashizume et al. (1974). From the results they found that the yield of four per cent fat corrected milk was significantly greater with dried beet pulp than with wet potato pulp, but there was no difference in fat, protein or solids-not-fat contents. Also there was no effect on the health, blood or urine of the cows.

The inclusion of 10 per cent mango seed kernels, a by-product of the canning industry, in the concentrate mixture fed to dairy cows had no adverse effect on milk and fat corrected milk yields over a period of 24 weeks. The use of mango seed kernel has therefore been suggested as a means

of alleviating the shortage of feed concentrates in India (Patel et al., 1970).

Rojas and Zevallos (1972) conducted an experiment in which ground maize cobs and cotton seed hulls replaced wheat bran in the rations of lactating cows and that there was a 11 per cent drop in daily milk yield ($P < 0.01$) compared with a concentrate mixture containing wheat bran. There was a six per cent drop in four per cent fat corrected milk also highly significant, although the average daily fat yield was seven gram higher than for the wheat bran concentrate.

Effect of feeding silk cotton seed cake on milk production by replacing 50 or 100 per cent of the gingelly oil cake in the concentrate mixture was studied by Muniyappa (1972). It was observed that eventhough there were no significant differences between feeds, 50 per cent replacement of gingelly oil cake by silk cotton seed cake helped to support the maintenance of the body weight, butter fat production and milk yield.

Schingoethe et al. (1977) evaluated sun flower meal as a protein supplement for lactating cows. Isonitrogenous ration containing either soybean meal or sun flower meal replacement of 60 per cent of the crude protein in the ration were used for the study. The results indicated that the milk

yield and composition, feed consumption and body weight were not affected by the diet.

Effect of feeding protected Safflower oil on yield, composition and flavour of milk was studied by Goering et al. (1976). They found that linoleic acid content of the milk fat was increased from a mean of 2.7 per cent for non-supplemented cows to 13.3 per cent for the supplemented cows. Milk fat and protein yields fat and protein percentages were not affected by the supplementation. No health or feeding problems were observed. Off flavours, predominantly of an oxidised nature, readily developed in milk containing high linoleic acid content.

The effects of addition of linseed and rape seed oils at a level of five per cent to the feed concentrate mixture was studied by Momb et al. (1958) in a feeding trial with milking cows. No definite differences were observed between the two feed treatments in terms of milk yield, flavour of the milk or the health of the animals. A comparison was made to find out the palatability of toasted and untoasted rape seed meal by Grenet and Journet (1971). It was found that toasting had little effect on palatability, except for shortening the eating time.

The effect of incorporating commercially dried banana meal in concentrates for dairy cows was studied by Riha and

Isler (1976). Cows, continuously on pasture, were given concentrate with 50 per cent maize, 50 or 90 per cent banana meal. The banana meal was prepared from commercially dried, chopped unpeeled green rejects of bananas. The other ingredients were cotton seed cake, molasses, calcium sulphate, coconut cake and rice bran except in the third group which had urea. Results indicated that there was no significant difference between the groups for intake of concentrate, milk output and quality of milk.

Rodriguez and Gonzalez (1973) conducted an experiment to find out the use of filter cake mud, a sugar industry by-product, containing nine per cent protein, 13 per cent fibre and 32 per cent ash, in integral diets for milk production. The cake was included at 0, 5, 10 and 15 per cent level on the drymatter of complete feeds. Results indicated that yield of milk and four per cent fat corrected milk were not affected by the different levels of filter cake mud. The milk fat percentage was found to be low with all diets. There was no significant differences in the drymatter consumption or weight gain.

The feeding value of beet pulp for milk production has been studied by Bhattacharya and Sleiman (1971). There was no significant difference in fat corrected milk yield or change in body weight between cows fed on experimental

concentrate ration containing 55 per cent beet pulp and controls fed with a concentrate ration containing 57 per cent ground barley. In an another experiment, addition of four per cent tallow to a fat-deficient concentrate ration containing 50 per cent beet pulp and 19 per cent wheat bran resulted in a significant increase ($P < 0.01$) in four per cent fat-corrected milk than in the control animals receiving unsupplemented concentrate. Castle (1972) concluded after conducting an experiment, that for practical purposes dried sugar beet pulp and barley are interchangeable on an equal weight basis in dairy cow feeds without affecting the milk yield, solids-not-fat or protein.

Experiment conducted in Haryana cows showed that Bijada cake, a by-product obtained from watermelon seeds after extraction of the oil, had no adverse effects on milk yield, fat per cent or protein per cent when fed at a level of 500 g/day. It was recommended that the cake can be fed at 20 per cent level for growing calves and lactating cows (Sastry et al., 1973).

The feeding of sugar beet to cows was found to increase the fat content of milk, and to decrease the lactose content, but the differences were not statistically significant. Protein and ash contents and the fat : solids-not-

fat ratio remained unchanged (Saito and Tanno, 1962). Obracevic et al. (1971) found that there was a decrease in milk yield when the sugar beet was increased in the ration. They also showed a fall in milk fat content during the first 20 days of the study but that was reversed by adaptation. It was probably related to high concentration of lactic and butyric acids and low proportions of acetic acid in the rumen during the period of adaptation.

Otagaki et al. (1961) reported that milk yield, butter fat content and milk quality, assessed by rancidity and flavour scores, remained satisfactory when 30 per cent of a basal ration containing 40 per cent pineapple bran was replaced by pineapple bran or pineapple hay. Pineapple hay appeared to be a potential source of medium quality roughage for dairy cows. Bishop and Nell (1974) conducted continuous stall feeding of pineapple silage as the only source of roughage for dairy cattle. Four groups consisting of heifer calves, first calvers, second calvers and mature cows of Jersey breed were used for this purpose. Results showed that the average intake of silage by lactating and dry cow was 26.3 and 27.6 kg/day. The first and second lactation cows produced more milk than the herd average. As the experiment progressed, the cows given pineapple silage produced less milk in their next lactation. The yields in the first lactation heifers were less than the herd average. The cows getting the silage lost

more live weight during lactation, and calves born to cows after the second experimental lactation were significantly lighter than the herd average. The cows in the experimental groups developed depressed appetite and coat abnormalities. Feeding of 2.7 kg lucerne removed these defects. A feeding trial was conducted to compare the feeding value of pineapple bran and a mixture of meal in dairy animals by Stanley et al. (1976). Results showed that there was no difference in yield or composition of milk or intake of feeds. The cows on the pineapple steam meals gained body weight whereas those on the bran lost the weight.

Mertens et al. (1971) compared rations in which cotton seed hulls in a complete ration were replaced by either 10 or 20 per cent paper that was ground in a hammer mill. The cows that received 20 per cent paper in the diet had significantly lower milk yields than the other two groups, but the differences in four per cent fat-corrected milk were not significant. The fat content of the milk of the cows that were fed paper was on the increase. The milk from the paper fed cows had a normal flavour.

Orud and Homb (1964) reported no significant differences in milk yield, four per cent fat-corrected milk or weight gains in experimental and control groups of dairy cows when sea weed meal was fed to them. In another experiment Desai

and Shukla (1974) concluded that sea weed can be incorporated in the concentrate mixture upto 30 per cent level without any detrimental effect on yield or composition.

In comparison to maize, cassava included in the concentrate mixture was found to give higher milk yields, four per cent fat-corrected milk and solids-corrected milk. Milk of cows given cassava had significantly more solids-not-fat than that of cows getting maize, but there was no significant difference in fat or protein content (Olaloku et al., 1971). Ananthasubramaniam (1972) suggested that tapioca leaf meal can be incorporated in the rations of dairy animals at a level of 0.4 per cent of their body weight without affecting the daily milk yield, body weight gain or total butter fat production.

Mello et al. (1973) found that on an Isonitrogenous and Iso-caloric base, cotton seed meal can be replaced by poultry litter in the ration of milking cows. Results showed that even with 100 per cent substitution there were no significant effects on milk yield, fat yield, density, acidity, flavour, odour, fat, total solids or solids-not-fat contents. Feed consumption was not affected and there were apparently no effects on health. Silva et al. (1976) in a different experiment concluded that poultry litter can be included in the dairy ration only upto 10 per cent level without affecting the yield

or feed consumption. The protein, solids-not-fat and total solids percentage showed a downward trend when the percentage of dried poultry waste was increased in the ration. Ratfon containing more than 10 per cent dried poultry waste were found to reduce the feed intake and milk yield.

From the foregoing literature it will be seen that there are many unconventional feeds and fodders which can easily be used in the ration of dairy cows for meeting the shortage of cattle feeds in the country and to bring down the cost of feed for milk production. There may be several other unconventional feeds that need investigation on the feeding values for the various species of livestock.

MATERIALS AND METHODS

MATERIALS AND METHODS

An experiment was carried out to determine the effect of feeding tea waste in dairy cows for milk production by replacing part of the wheat bran in the concentrate mixture, following a switch-over design of three dietary treatments spread over a period of 30 days each.

Nine Jersey x Sindhi crossbred cows maintained at the University Livestock Farm, Mannuthy and divided into three groups of three animals each as uniformly as possible with regard to yield and stage of lactation formed the subjects of the study (Tables 4 and 5).

Maize, groundnut cake and wheat bran formed the chief ingredients in the concentrate mixture used for the experiments. The tea waste used as an ingredient was supplied by M/s Food Specialities Limited, Choladi Factory, Nilgiris, Tamil Nadu. The dried tea waste received from the factory contained on an average 11.38 per cent of moisture and had the following composition on drymatter basis:

Crude protein	26.80
Ether extract	3.10
Crude fibre	19.80
Total ash	6.40

Acid insoluble ash	1.20
Nitrogen free extract	43.90
Calcium	1.10
Phosphorus	0.45

The composition of concentrate mixtures used for the feeding trials are given hereunder.

Table 1. Percentage composition and cost of the concentrate mixture C (control diet - 0 per cent tea waste)

Ingredients	Percentage	Cost/100 kg	DCP	TDN
Groundnut cake	34	72.76	13.94	23.80
Maize	30	42.90	2.10	25.20
Tea waste	..	..	..	..
Wheat bran	33	47.85	3.30	22.11
Salt	2	0.48	..	..
Mineral mixture*	1	6.30	..	..
Total	100	170.29	19.34	71.11

* Calciphos supplied by M/s Cheeran & Co.

Table 2. Percentage composition and cost of the concentrate mixture A (Experimental diet - 15 per cent tea waste)

Ingredients	Percentage	Cost/100 kg	DCP	TDN
Groundnut cake	34	72.76	13.94	23.80
Maize	30	42.90	2.10	25.20
Tea waste	15	1.35	1.50	6.50
Wheat bran	18	26.10	1.80	12.06
Salt	2	0.48	..	..
Mineral mixture*	1	6.30	..	..
Total	100	149.89	19.34	67.56

* Calciphos supplied by M/s Cheeran & Co.

Table 3. Percentage composition and cost of the concentrate mixture B (Experimental diet - 25 per cent tea waste)

Ingredients	Percentage	Cost/100 kg	DCP	TDN
Groundnut cake	33	70.62	13.53	23.10
Maize	32	45.76	2.24	26.88
Tea waste	25	2.25	2.50	10.30
Wheat bran	7	10.15	0.70	4.69
Salt	2	0.48	..	..
Mineral mixture*	1	6.30	..	..
Total	100	135.56	18.97	65.47

* Calciphos supplied by Cheeran & Co.

The concentrate mixtures were analysed for their contents of protein, fibre, fat, moisture, ash, acid insoluble ash, calcium and phosphorus as per the standard methods described in AOAC (1970).

The animals were housed in stalls and fed individually as per Sen and Ray Feeding Standards (1971). The total concentrate mixture was divided into two equal parts and fed in the morning and evening. In addition to the concentrate mixture the animals were provided with grass silage and clean water ad libitum.

The rations were interchanged in the order given below at the termination of each phase of the experiment lasting for 30 days.

	Group I			Group II			Group III		
Tatoo No. of the animals	C 57	639	640	651* (519)	937	643	667	513	355
	C	A	B	C	B	A	B	C	A
	B	C	A	B	A	C	A	B	C
	A	B	C	A	C	B	C	A	B

* During the second phase of the experiment Cow No. 651 died due to accident and Cow No. 519 having similar lactation yield and order was substituted for the rest of the experimental study.

The body weights of the cows used for the lactation study were determined by means of a platform weighing scale with an accuracy of 500 g. The animals were weighed in the morning before giving any feed. The animals were weighed at the commencement of the experiment and at the end of every phase. The daily milk yield of the individual cows was recorded to the nearest 100 g by using a herd recorder.

Blood samples for laboratory examination were collected using reagent grade Ethylenediamine tetra-acetic acid disodium salt (EDTA) as anticoagulant at the rate of 10 mg for every 10 ml of blood. About five ml of blood was drawn for haematological studies from the jugular vein under aseptic conditions

in the morning at the end of every phase of the experiment.

The method described by Coffin (1953) was adopted for finding out the R.B.C. count. The haemoglobin content was estimated by Wong's method as described by Oser (1964). The Wintrobe method as described by Kolmer et al. (1969) was used for the estimation of packed cell volume.

The samples of milk in proportion to the yield at each milking were collected from individual animals once in every 15 days and the samples were thoroughly mixed before the analyses were carried out.

The fat content of the milk was estimated using the Gerber's method as described in Indian Standards, IS 1224 (1958). The total solids content in the milk was estimated by Gravimetric method as per the procedure described in Indian Standards, IS 1479 Part II (1960). The solids-not-fat content in the milk samples was determined by substracting the fat percentage from the total solids percentage.

The fat-corrected milk was calculated using Gaine's formula. Four per cent fat-corrected milk = 0.4M + 15F where M = weight of milk and F = weight of fat contained in it (Maynard and Loosli , 1973). The solids-corrected milk was derived by the formula SCM (kg) = 12.3 (F) + 6.56 (SNF) minus 0.0752 (M) where SCM equals solids-corrected milk, F, SNF and M equal fat, solids-not-fat and milk respectively

expressed in kilograms (Tyrrell and Reid, 1965).

Butter was prepared from the milk samples collected at the end of every phase of the experiment. The melting point of butter fat was found out by capillary tube method as described by Woodman (1941). Saponification value was estimated for each sample as described by Woodman (1941). Hanus method as described by Woodman (1941) was used for the estimation of Iodine number.

The data obtained from the experiment were arranged in tables for statistical analyses. For the purpose of statistical analyses the data collected during the first seven days of each period of treatment have been excluded and the same for the next 23 days only have been included since the first seven days period has been considered as the pre-trial period. Statistical analyses were done according to standard methods (Snedecor and Cochran, 1967). The data from the three groups of animals on total milk production, butter fat yield, total solids yield, fat-corrected milk and solids-corrected milk were compared using analysis of variance technique. Students 't' test was applied to find out significant differences, if any, between the three treatment at different stages of the experiment.

RESULTS

RESULTS

Concentrate mixtures containing 0 (C), 15 (A) and 25% (B) tea waste in them were analysed for the chemical composition. The details of the chemical composition were given in Table 6.

The body weight (kg) of the cows under experimentation taken at the commencement and at the termination of each phase of the experiment are indicated in Table 7. The body weight of the animals ranged from 238 to 296 kg. The analysis of variance of the body weights of the animals showed (Table 8) that there was no significant difference in body weight due to three dietary treatments adopted for the experiment.

The animals were fed according to Sen and Ray (1971). Feeding standards. The total quantity of concentrate mixture consumed and the total consumption by the animals in each dietary treatment are set out in Table 9. The quantity of feed (kg) consumed by each animal during the different phases of the treatments varied from 79.5 to 115.0 in a period of 23 days. Tables 10, 11 and 12 give the daily milk yield (kg) of all the experimental cows during the first, second and third phases respectively. The maximum yield (kg) of milk was 11.3 and the minimum 3.0 for individual animals. The total quantity (kg) of milk produced by the individual cows

under experimentation during different phases are given in Table 13. The quantity of milk in different phases ranged from 84.7 to 207.1Kg. The analysis of variance of the total milk yield of the cows is shown in Table 14.

The percentage of fat in the milk of the cows at the commencement and the end of each phase is given in Table 15. The fat percentage of the milk was found to vary from 3.75 to 5.30. The analysis of variance regarding the percentage of fat is given in Table 16. Quantity of milk fat produced by the individual cows during each phase of the experiment is given in Table 17 and it ranged from 3.99 to 9.41 kg. The analysis of variance of the total milk fat yields of the cows is given in Table 18.

The total milk yield of the cows converted to four per cent fat-corrected milk is indicated in Table 19. The quantity of four per cent fat-corrected milk yielded by individual animals during different phases ranged from 93.73 to 223.99 kg. The analysis of variance of the total fat-corrected milk yield of the cows is presented in Table 20.

The percentage of total solids in the milk of experimental cows is presented in Table 21. The percentage of total solids was found to range from 12.20 to 14.58. The analysis of variance with respect to the percentage of total

solids in milk is presented in Table 22. Table 23 gives the quantity of total solids in milk of the individual cows during the different phases of the experiment. This quantity was found to be between 11.48 and 26.49 kg in the different phases. The analysis of variance of the total solid in milk of the cows is given in Table 24.

The percentage of solids-not-fat in the milk of cows under experimentation is given in Table 25. The values ranged from 7.61 to 9.50 per cent in the milk of individual cows. Table 26 shows the analysis of variance of the percentage of solids-not-fat in the milk. The total quantity of solids-not-fat in the milk of cows during the different phases are indicated in Table 27. During the different phases of the experiment the total solids-not-fat content was found to vary from 7.49 to 18.97. The analysis of variance of the solids-not-fat content in the milk of the cows is given in Table 28.

The total milk yield of the cows converted into solids-corrected milk are indicated in Table 29. The quantity of solids-corrected milk yielded by the individual animals during the different phases varied from 120.42 to 206.18 kg. The analysis of variance of the solids-corrected milk of the cows is presented in Table 30.

Samples of blood collected from the cows were used for

the determination of R.B.C. count, haemoglobin and packed cell volume. The R.B.C. count (million/mm^3) of the cows on different diets are furnished in Table 31.

The results of the estimation of the haemoglobin content (g/100 ml) in the blood samples of the cows under experiment are furnished in Table 32.

The values obtained for the packed cell volume (%) is tabulated in Table 33.

Samples of butter fat obtained from the milk of the experimental cows were analysed for the physical and chemical constants. The melting point (0^C), iodine number (g/100 g) and saponification number (mg/g) of the butter fat samples are presented in Table 34. The analysis of variance of the physical and chemical constants of the butter fat samples analysed are tabulated in Table 35.

The economics of incorporating tea waste in the concentrate ration of cows for milk production has been worked out and presented in Fig. 1.

Table 4. Age and details of lactation of experimental cows

Sl. No.	Cow No.	Date of birth	Date of last calving	Average daily milk yield (kg)	No. of d in milk the comm cement
1	C57	21-5-74	28-9-77	8.6	100
2	639	28-10-74	11-10-77	8.7	86
3	640	8-1-75	20-10-77	8.5	77
4	651	20-3-75	29-11-77	8.8	97
5	519	29-6-75	12-12-77	4.5	73
6	937	17-7-68	20-11-77	9.4	46
7	643	12-12-74	5-9-77	8.7	122
8	667	4-8-75	7-11-77	10.5	59
9	513	15-5-75	10-12-77	10.2	26
10	355	20-4-73	20-10-77	9.8	75

Table 5. Grouping of animals for different treatments.

Treatment	First phase	Second phase	Third phase
	057	639	640
Diet C	651	643	937
	513	355	667
	639	640	057
Diet A	643	937	651* (519)
	355	667	513
	640	057	639
Diet B	937	651* (519)	643
	667	513	355

* Cow No. 651 substituted by Cow No. 519.

Diet C = Concentrate mixture containing tea waste at 0% level.

Diet A = Concentrate mixture containing tea waste at 15% level.

Diet B = Concentrate mixture containing tea waste at 25% level.

Table 6. Chemical composition of the concentrate mixtures used for the experiment - Percentage basis.

Sl. No.	Constituents	Concentrate mixture with 0% tea waste (O)	Concentrate mixture with 15% tea waste (A)	Concentrate mixture with 25% tea waste (B)
1	Moisture	7.89	7.33	7.69
2	Crude protein	23.68	23.56	24.19
3	Ether extract	4.28	4.11	5.00
4	Crude fibre	5.00	6.00	8.00
5	Nitrogen free extract	53.90	54.07	50.28
6	Total ash	5.25	4.93	4.24
7	Acid insoluble ash	0.98	0.81	0.92
8	Calcium	0.71	0.69	0.73
9	Phosphorus	0.25	0.44	0.31

Table 7. Body weights (kg) of cows under experimentation.

Animal number	At the commencement	At the end of the first phase	At the end of the second phase	At the end of third phase
		DIET-C	DIET-B	DIET-A
C57	273.0	272.0	266.0	262.0
651 (519)	241.5	242.0	245.0	247.0
513	243.5	244.5	242.0	240.0
		DIET-A	DIET-C	DIET-B
639	251.0	250.5	246.0	241.0
643	254.0	255.5	251.0	243.0
355	251.0	251.5	253.0	254.0
		DIET-B	DIET-A	DIET-C
640	247.5	246.0	241.0	238.0
937	292.5	293.5	290.0	296.0
667	259.0	255.0	257.0	263.0

Table 8. Body weight of animals - Analysis of variance.

Source	df	SS	MSS	F
Between periods	2	125.72	62.86	
Between treatments	2	66.89	33.45	0.04
Error	4	3683.11	920.78	
Total	8	3875.72		

Table 9. Quantity of concentrate mixture (kg) consumed by cows under experimentation.

Animal number	At the end of first phase	At the end of second phase	At the end of third phase	Total
	DIET-C	DIET-B	DIET-A	
057	100.00	79.50	89.95	269.45
651 (519)	108.00	115.00	115.00	338.00
513	107.00	80.70	114.25	301.95
Total	315.00	275.20	319.20	909.40
	DIET-A	DIET-C	DIET-B	
639	113.75	115.00	104.00	332.75
643	115.00	115.00	115.00	345.00
355	115.00	115.00	114.20	344.20
Total	343.75	345.00	333.20	1021.95
	DIET-B	DIET-A	DIET-C	
640	115.00	113.30	114.70	343.00
937	115.00	111.20	113.75	339.95
667	115.00	114.00	115.00	344.00
Total	345.00	338.50	343.45	1026.95

Table 10. Daily milk yield (kg) of animals under experimentation - First phase.

Diet	Animal number	Days 1	2	3	4	5	6	7	8	9	10	11	12
C No tea waste	057	7.0	8.9	9.5	7.4	6.7	6.6	6.2	6.3	6.5	8.5	6.5	6.7
	651	8.4	8.6	8.5	8.4	9.0	9.8	8.9	8.6	8.3	7.7	7.8	7.6
	513	10.6	11.0	11.3	11.2	7.9	10.9	9.1	7.6	6.1	5.7	6.8	9.3
A Tea waste at 15% level	639	6.6	6.8	6.9	7.2	6.9	6.9	7.0	7.0	7.0	7.0	7.4	6.4
	643	8.1	7.8	8.4	7.6	7.8	7.7	7.5	7.6	5.9	3.1	4.4	4.7
	355	7.7	7.6	8.0	7.1	8.2	8.1	7.9	7.6	6.6	7.9	6.6	7.0
B Tea waste at 25% level	640	8.0	7.5	7.8	7.7	7.4	7.6	7.9	7.3	7.0	7.2	7.9	7.1
	937	7.6	8.5	8.4	7.8	8.7	9.1	8.9	8.6	7.6	8.1	7.0	7.8
	667	9.8	9.1	9.3	7.8	7.2	8.4	8.6	6.7	6.6	5.8	7.6	6.0

(Table 10 contd.....)

Diet	Animal number	Days 13	14	15	16	17	18	19	20	21	22	23	Total
C No tea waste	C57	6.6	6.6	6.1	6.3	5.6	5.9	6.0	7.4	5.6	5.7	5.8	154.4
	651	7.3	7.9	7.7	7.8	8.0	8.1	8.2	7.9	7.4	7.9	8.3	188.1
	513	7.9	10.1	9.8	9.1	9.5	9.7	9.6	9.3	8.1	7.5	9.0	207.1
A Tea waste at 15% level	639	6.9	7.1	6.7	7.4	6.9	7.1	7.2	7.3	6.6	7.1	6.8	160.2
	643	6.1	6.9	7.3	7.9	7.5	7.5	7.6	7.7	7.2	8.0	7.9	162.2
	355	7.1	7.5	7.4	7.7	8.2	8.2	7.7	7.5	5.9	7.7	7.9	173.1
B Tea waste at 25% level	640	6.8	7.6	7.2	6.7	7.1	7.5	6.9	6.6	6.3	6.9	7.5	167.5
	937	7.8	6.7	8.0	7.0	8.3	7.8	7.5	8.0	8.1	7.1	8.3	182.7
	667	8.0	8.6	7.8	7.7	7.9	7.0	7.3	8.0	6.9	7.0	7.6	176.7

(Table 10 concl.)

Table 11. Daily milk yield (kg) of animals under experimentation - Second phase.

Diet	Animal number	Days 1	2	3	4	5	6	7	8	9	10	11	12
B Tea waste at 25% level	057	4.9	4.3	4.9	4.7	5.1	4.6	5.0	4.7	4.6	4.9	4.7	5.1
	651 (519)	7.2	6.9	6.7	7.5	7.0	6.9	6.4	6.6	6.1	6.0	6.6	5.9
	513	9.5	9.4	9.3	9.3	8.5	9.8	9.2	9.4	9.5	9.2	9.8	9.1
C No tea waste	639	6.7	5.8	6.7	6.7	7.1	7.3	6.5	5.9	6.7	6.6	5.8	6.3
	643	7.2	7.7	8.0	8.0	8.2	9.5	8.6	8.4	9.0	9.4	8.4	8.6
	355	7.1	7.3	7.8	9.6	7.3	8.1	8.3	8.3	7.9	9.1	7.4	8.5
A Tea waste at 15% level	640	5.9	6.4	6.5	5.7	5.1	5.7	6.5	5.6	6.4	6.4	7.1	7.1
	937	8.4	7.3	8.7	7.9	9.2	8.6	8.5	8.8	8.4	8.2	7.5	9.6
	667	8.3	7.9	7.0	8.0	8.7	8.9	8.2	9.0	8.1	8.2	7.2	8.8

(Table 11 contd.....)

Diet	Animal number	Days 13	14	15	16	17	18	19	20	21	22	23	Total
B Tea waste at 25% level	C57	4.2	5.7	4.2	5.7	4.3	4.4	4.4	3.7	4.0	3.6	4.2	105.90
	651 (519)	6.5	5.6	5.4	5.8	5.3	4.2	5.4	5.5	5.2	7.6	5.5	141.80
	513	8.3	8.6	8.5	8.6	8.6	8.7	8.2	8.3	8.2	7.3	8.1	203.40
C No tea waste	639	6.9	6.6	6.5	6.3	5.6	6.0	6.1	5.5	5.3	6.0	5.8	144.60
	643	6.4	6.0	7.9	8.1	7.7	8.1	7.5	7.7	7.3	8.0	7.5	183.40
	355	7.3	7.4	7.0	5.9	3.1	6.5	8.1	8.1	8.5	7.6	6.9	178.10
A Tea waste at 15% level	640	5.1	6.1	5.2	6.1	5.0	6.0	6.5	3.4	5.0	4.8	5.8	139.20
	937	7.7	7.5	7.3	8.3	7.2	7.2	6.9	8.7	6.7	7.5	7.6	183.70
	667	7.6	8.3	8.7	6.8	8.3	7.4	6.9	7.6	7.8	8.8	7.2	183.70

(Table 11 concl.)

Table 12. Daily milk yield (kg) of animals under experimentation - Third phase.

Diet	Animal number	Days 1	2	3	4	5	6	7	8	9	10	11	12
A Tea waste at 15% level	057	4.1	4.1	4.4	4.2	3.9	3.7	3.6	4.0	3.1	3.7	3.6	3.9
	651 (519)	5.8	6.0	6.0	6.0	5.5	6.0	8.0	5.5	5.3	5.2	5.0	5.4
	513	8.0	7.1	8.5	8.9	8.3	7.5	7.2	7.6	8.1	8.4	7.4	8.1
B Tea waste at 25% level	639	6.2	5.2	5.8	5.8	5.6	5.3	5.3	5.4	4.6	5.5	5.3	4.7
	643	6.9	7.8	6.2	5.5	5.8	5.0	5.9	5.7	6.0	6.0	6.1	5.7
	355	6.8	6.8	7.1	6.3	7.1	6.8	6.0	6.8	5.1	6.6	6.7	6.7
C No tea waste	640	6.2	5.1	6.4	6.1	6.8	5.3	5.9	5.2	5.0	5.0	5.6	4.5
	937	7.2	8.1	7.2	8.0	7.4	6.9	7.2	7.7	6.9	6.9	7.4	7.1
	667	7.3	8.0	7.3	7.1	8.2	7.1	5.8	6.6	6.7	6.9	7.3	7.0

(Table 12 contd.....)

Diet	Animal number	Days 13	14	15	16	17	18	19	20	21	22	23	Total
A Tea waste at 15% level	657	3.8	3.6	3.9	3.5	3.6	3.4	3.5	3.2	3.2	3.0	3.7	84.70
	651 (519)	5.3	5.2	5.7	5.3	5.4	5.3	5.4	5.1	5.3	5.5	6.1	129.30
	513	8.6	6.7	7.4	7.7	8.0	8.2	8.6	8.1	7.1	6.3	6.7	178.50
B Tea waste at 25% level	639	5.1	4.9	4.8	4.7	4.3	4.2	4.7	4.5	4.9	4.4	4.5	115.70
	643	5.5	4.7	5.4	5.3	5.4	5.6	5.4	5.6	5.8	5.6	5.6	132.50
	355	6.2	7.0	6.3	5.8	5.9	5.8	6.4	6.6	5.6	6.2	6.0	146.60
C No tea waste	640	5.1	5.2	4.4	4.2	5.0	4.7	4.5	4.8	4.7	4.4	4.0	118.10
	937	6.8	6.6	7.2	7.1	5.7	7.6	7.1	7.5	7.9	7.4	6.5	165.40
	667	6.9	7.3	7.5	7.2	7.3	7.4	7.6	7.6	7.1	7.2	6.7	165.10

(Table 12 concl.)

Table 13. Quantity of milk (kg) produced by cows under experimentation.

Animal number	First phase	Second phase	Third phase	Total
	DIET-C	DIET-B	DIET-A	
657	154.40	105.90	84.70	345.00
651 (519)	188.10	141.80	129.30	459.20
513	207.10	203.40	178.50	589.00
Total	549.60	451.10	392.50	1393.20
	DIET-A	DIET-C	DIET-B	
639	160.20	144.60	115.70	420.50
643	162.20	183.40	132.50	478.10
355	173.10	178.10	146.60	497.90
Total	495.50	506.10	394.80	1396.40
	DIET-B	DIET-A	DIET-C	
640	167.50	139.20	118.10	424.80
937	182.70	193.70	165.40	531.80
667	176.70	183.70	165.10	525.50
Total	526.90	506.60	448.60	1482.10

Table 14. Total milk yield - Analysis of variance.

Source	df	SS	MSS	F
Between animals	8	13937.09	1742.14	
Between periods within squares	6	7660.40	1276.73	
Between treatments	2	1098.11	549.06	7.78**
Error	10	706.10	70.61	
Total	26	23401.70		

Pair wise comparison

C	A	B
167.14	154.96	152.59

CD = 12.55
A-B = 2.37
C-A = 12.18*
B-C = 14.55**

** Significant at 1% level.
* Significant at 5% level.

Table 15. Average percentage of fat in milk of cows under experimentation.

Animal number	At the commencement	First phase	Second phase	Third phase
		DIET-C	DIET-B	DIET-A
C57	5.30	5.60	4.58	4.71
651 (519)	4.90	4.39	4.33	4.39
513	4.70	4.54	3.75	4.76
		DIET-A	DIET-C	DIET-B
639	4.50	4.85	4.88	4.43
643	4.70	4.90	4.71	3.85
355	4.70	4.74	4.49	4.67
		DIET-B	DIET-A	DIET-C
640	4.30	4.60	3.97	4.46
937	4.70	4.31	4.30	4.47
667	4.80	4.93	3.98	4.82

Average C = 4.71 ± 0.35

A = 4.50 ± 0.36

B = 4.37 ± 0.22

Table 16. Percentage of fat in milk of the experimental cows - Analysis of variance.

Source	df	SS	MSS	F
Between animals	8	1.075	0.134	
Between periods within squares	6	1.615	0.269	
Between treatments	2	0.512	0.256	3.765
Error	10	0.676	0.068	
Total	26	3.878		

Table 17. Quantity of milk fat (kg) produced by cows under experimentation.

Animal number	First phase	Second phase	Third phase	Total
	DIET-C	DIET-B	DIET-A	
C57	8.65	4.85	3.99	17.49
651 (519)	8.25	6.14	5.68	20.07
513	9.41	7.62	8.49	25.52
Total	26.31	18.61	18.08	63.08
	DIET-A	DIET-C	DIET-B	
639	7.77	7.06	5.13	19.96
643	7.95	8.63	5.10	21.69
355	8.21	7.99	6.85	23.05
Total	23.93	23.68	17.08	64.69
	DIET-B	DIET-A	DIET-C	
640	7.71	5.52	5.27	18.50
937	7.88	7.90	7.39	23.17
667	8.54	7.12	7.96	23.62
Total	24.13	20.54	20.62	65.29

Table 18. Total fat yield - Analysis of variance.

Source	df	SS	MSS	F
Between animals	8	18.45	2.31	
Between periods within squares	6	25.04	4.17	
Between treatments	2	6.96	3.48	15.82**
Error	10	2.22	0.22	
Total	26	201.55		

Pair wise comparison

C	A	B
7.85	6.96	6.65

CD = 0.70
A-B = 0.31
C-A = 0.89**
B-C = 1.20**

** Significant at 1% level.

Table 19. Quantity of fat-corrected milk (kg) produced by the cows under experimentation.

Animal number	First phase	Second phase	Third phase	Total
	DIET-C	DIET-B	DIET-A	
657	191.51	115.11	93.73	400.35
651 (519)	198.99	148.82	135.72	483.53
513	223.99	195.66	198.75	618.40
Total	614.49	459.59	428.20	1502.29
	DIET-A	DIET-C	DIET-B	
639	180.63	163.74	123.23	467.60
643	194.13	202.81	129.50	516.44
355	192.39	191.09	161.39	544.87
Total	557.15	557.64	414.12	1528.91
	DIET-B	DIET-A	DIET-C	
640	182.65	138.48	126.29	447.42
937	191.28	191.98	177.01	560.27
667	198.78	180.28	185.44	564.50
Total	572.71	510.74	488.74	1572.19

Table 20. Four per cent fat-corrected milk - Analysis of variance.

Source	df	SS	MSS	F
Between animals	8	11253.86	1406.73	
Between periods within squares	6	12871.85	2145.31	
Between treatments	2	3579.57	1789.29	8.00**
Error	10	2236.18	223.62	
Total	26	29940.46		

Pair wise comparison

C	A	B
184.54	159.57	160.71

CD = 22.34
A-B = 1.14
C-A = 24.97**
B-C = 23.93**

** Significant at 1% level.

Table 21. Percentage of total solids in milk of cows under experimentation.

Animal number	At the commencement	First phase	Second phase	Third phase
		DIET-C	DIET-B	DIET-A
657	14.46	14.58	13.89	13.55
651 (519)	13.59	12.20	13.45	12.68
513	14.18	12.35	13.02	12.72
		DIET-A	DIET-C	DIET-B
639	13.67	13.43	14.02	13.32
643	13.53	12.76	13.65	12.64
355	14.20	13.46	12.79	13.63
		DIET-B	DIET-A	DIET-C
640	12.95	13.28	12.12	12.79
937	13.18	12.59	12.49	12.79
667	13.90	12.46	12.74	13.47

Average A = 12.88 ± 0.46
B = 13.14 ± 0.47
C = 13.18 ± 0.75

Table 22. Percentage of total solids in milk of the experimental cows - Analysis of variance.

Source	df	SS	MSS	F
Between animals	8	5.320	0.665	
Between periods within squares	6	1.683	0.281	
Between treatments	2	0.473	0.237	1.203
Error	10	1.971	0.197	
Total	26	9.447		

Table 23. Quantity of total solids (kg) in milk of cows under experimentation.

Animal number	First phase	Second phase	Third phase	Total
	DIET-C	DIET-B	DIET-A	
057	22.51	14.71	11.48	48.70
651 (519)	22.94	19.07	16.40	58.41
513	25.57	26.49	22.70	74.76
Total	71.02	60.27	50.58	181.87
	DIET-A	DIET-C	DIET-B	
639	21.51	20.28	15.41	57.20
643	20.69	25.04	16.75	62.48
355	23.30	22.78	19.98	66.06
Total	65.50	68.10	52.14	185.74
	DIET-B	DIET-A	DIET-C	
640	22.25	16.37	15.10	54.22
937	23.00	22.94	21.16	67.10
667	22.02	23.40	22.24	67.66
Total	67.27	63.21	58.50	188.98

Table 24. Yield of total solids in milk - Analysis of variance.

Source	df	SS	MSS	F
Between animals	3	170.24	21.28	
Between periods within squares	6	145.31	24.22	
Between treatments	2	20.79	10.40	5.15*
Error	10	20.24	2.02	
Total	26	356.58		

Pair wise comparison

C	A	B
21.96	19.91	19.96

CD = 1.47
A-B = 0.05
C-A = 2.05*
B-C = 2.00*

*Significant at 5% level.

Table 25. Percentage of solids-not-fat in milk of cows under experimentation.

Animal number	At the commencement	First phase	Second phase	Third phase
		DIET-C	DIET-B	DIET-A
C57	9.16	8.98	9.31	8.84
651 (519)	8.69	7.81	9.10	8.35
513	9.48	7.80	9.28	7.96
		DIET-A	DIET-C	DIET-B
639	9.17	8.58	9.14	8.80
643	8.83	7.85	8.95	8.79
355	9.50	8.71	8.30	8.98
		DIET-B	DIET-A	DIET-C
640	8.55	8.68	8.15	8.32
937	8.48	8.28	8.19	8.33
667	9.10	7.61	8.86	8.65

Average A = 8.39 ± 0.36
B = 8.76 ± 0.51
C = 8.48 ± 0.46

Table 26. Percentage of solids-not-fat in milk of experimental cows - Analysis of variance.

Source	df	SS	MSS	F
Between animals	8	1.724	0.216	
Between periods within squares	6	0.054	0.009	
Between treatments	2	0.915	0.458	1.171
Error	10	3.914	0.391	
Total	26	6.607		

Table 27. Quantity of solids-not-fat in milk of cows under experimentation.

Animal number	First phase	Second phase	Third phase	Total
	DIET-C	DIET-B	DIET-A	
057	13.87	9.86	7.49	31.22
651 (519)	14.69	12.90	10.80	38.39
513	16.16	19.87	14.21	49.24
Total	44.72	41.63	32.50	118.85
	DIET-A	DIET-C	DIET-B	
639	13.74	13.22	10.27	37.23
643	12.74	16.41	11.64	40.79
355	15.08	14.79	13.12	42.99
Total	41.56	44.72	35.03	121.01
	DIET-B	DIET-A	DIET-C	
640	14.54	11.35	9.83	35.72
937	15.12	15.04	13.78	43.94
667	13.44	16.27	14.28	43.99
Total	43.10	42.66	37.89	123.65

Table 28. Total solids-not-fat yield - Analysis of variance.

Source	df	SS	MSS	F
Between animals	8	76.89	9.61	
Between periods within squares	6	59.32	9.89	
Between treatments	2	6.23	3.12	2.52
Error	10	12.42	1.24	
Total	26	154.86		

Table 29. Quantity of solids-corrected milk (kg) produced by cows under experimentation.

Animal number	First phase	Second phase	Third phase	Total
	DIET-C	DIET-B	DIET-A	
C57	185.77	116.38	91.84	393.99
651 (519)	183.70	149.48	130.99	464.17
513	206.18	202.22	194.23	592.63
Total	575.65	468.08	407.06	1450.79
	DIET-A	DIET-C	DIET-B	
639	173.65	162.69	121.77	458.11
643	169.16	200.01	129.13	498.30
355	186.88	181.91	159.31	528.10
Total	529.69	544.70	410.21	1484.68
	DIET-B	DIET-A	DIET-C	
640	177.61	131.89	120.42	429.92
937	182.37	182.02	168.86	533.25
667	177.92	180.50	179.17	537.59
Total	537.90	494.41	468.45	1500.76

Table 30. Solids-corrected milk - Analysis of variance

Source	df	SS	MSS	F
Between animals	8	10208.34	1276.04	
Between periods within squares	6	9884.85	1647.48	
Between treatments	2	2029.97	1014.99	10.77**
Error	10	942.03	94.20	
Total	26	23065.19		

Pair wise comparison

C	A	B
176.52	159.02	157.35

CD = 14.49
A-B = 1.67
C-A = 17.50**
B-C = 19.17**

** Significant at 1% level.

Table 31. R.B.C. count (million/mm^3) of the blood of experimental cows.

Animal number	At the commencement	First phase	Second phase	Third phase
		DIET-C	DIET-B	DIET-A
657	3.35	5.79	6.15	6.22
651 (519)	4.64	5.67	4.86	4.60
513	4.21	5.01	6.83	5.89
		DIET-A	DIET-C	DIET-B
639	5.06	7.39	6.67	5.47
643	4.93	5.28	5.03	6.99
355	4.14	5.85	5.66	4.71
		DIET-B	DIET-A	DIET-C
640	4.50	5.07	6.52	4.67
937	4.90	5.30	5.51	4.91
667	4.47	4.98	6.92	6.17

Table 32. Haemoglobin content (g/100 ml) of the blood of the experimental cows.

Animal number	At the commencement	First phase	Second phase	Third phase
		DIET-C	DIET-B	DIET-A
057	10.50	11.00	12.47	11.31
651 (519)	12.00	11.00	10.44	10.59
513	10.00	10.50	8.41	12.47
		DIET-A	DIET-C	DIET-B
639	9.00	12.00	9.72	9.43
643	9.00	9.40	10.01	10.15
355	8.00	8.50	9.30	9.43
		DIET-B	DIET-A	DIET-C
640	9.00	11.00	9.40	9.43
937	10.50	9.50	9.30	11.31
667	11.00	11.50	9.28	11.02

Table 33. Packed cell volume (%) of the blood of experimental cows.

Animal number	At the commencement	First phase	Second phase	Third phase
		DIET-C	DIET-B	DIET-A
657	48	36	41	49
651 (519)	41	36	41	34
513	45	43	31	35
		DIET-A	DIET-C	DIET-B
639	42	39	40	32
643	41	40	32	42
355	30	36	31	32
		DIET-B	DIET-A	DIET-C
640	40	33	39	35
937	44	33	39	39
667	43	42	43	36

Table 35. Analysis of variance of physical and chemical constants of butter fat.

Melting point

Source	df	SS	MSS	F
Between periods	2	0.23	0.12	
Between treatments	2	0.23	0.12	0.43
Error	4	1.10	0.28	
Total	8	1.56		

Iodine number

Source	df	SS	MSS	F
Between periods	2	16.64	8.32	
Between treatments	2	9.43	4.72	0.79
Error	4	23.91	5.95	
Total	8	49.98		

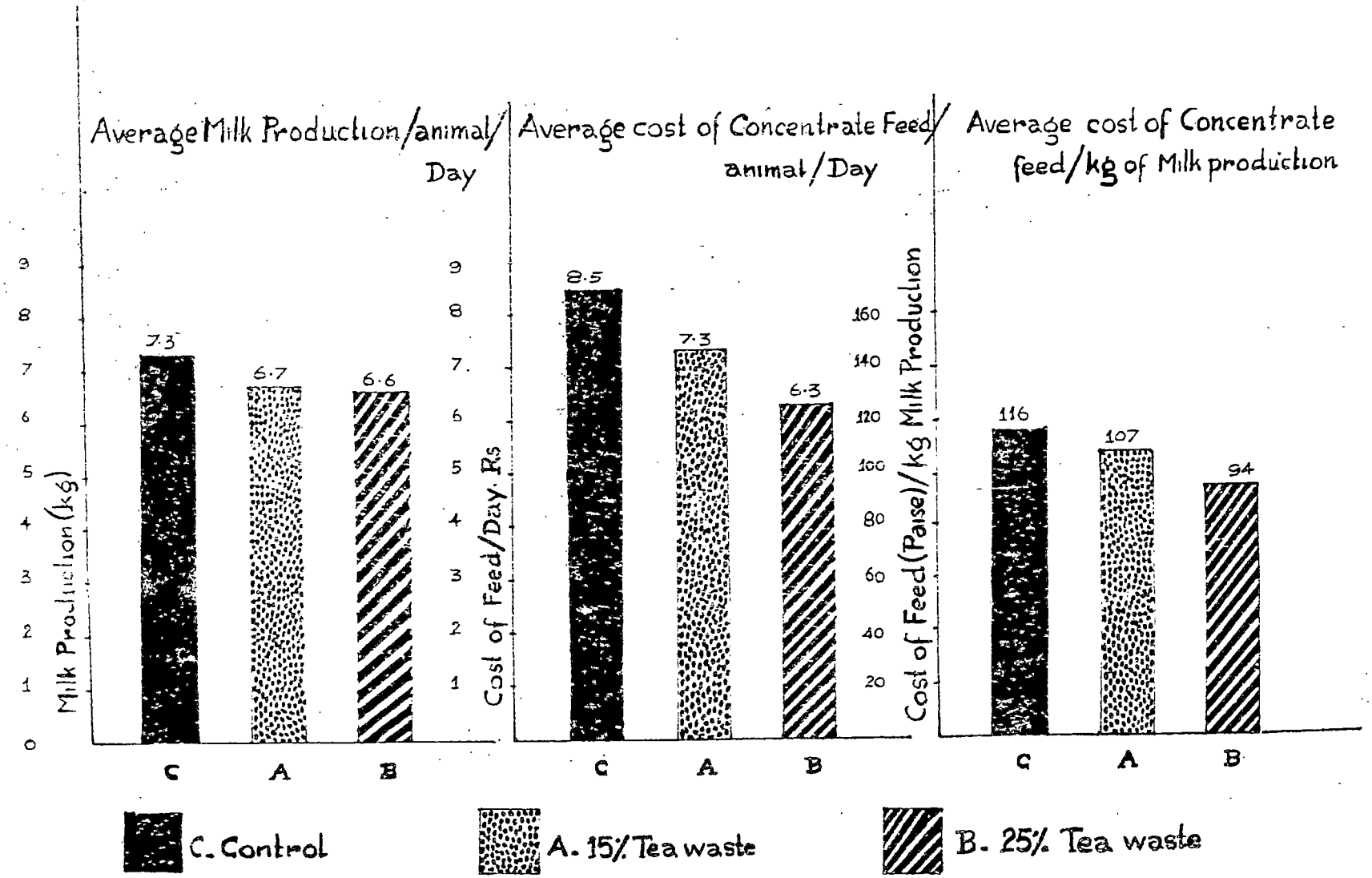
Saponification number

Source	df	SS	MSS	F
Between periods	2	188.94	94.47	
Between treatments	2	16.61	8.31	0.87
Error	4	38.14	9.54	
Total	8	243.69		

Table 34. Average physical and chemical constants of the butter fat of experimental cows.

Treatment group	Melting point °C			Iodine number (g/100g)			Saponification number (mg/g)		
	First phase	Second phase	Third phase	First phase	Second phase	Third phase	First phase	Second phase	Third phase
Group C No tea waste	27	27	27	29.20	21.48	22.15	218.08	224.47	229.43
Group A Tea waste at 15% level	26	27	27	21.50	22.30	22.85	225.61	222.44	233.23
Group B Tea waste at 25% level	27	26	27	24.60	23.40	21.20	224.69	220.64	234.45

Fig-1 EFFECT OF FEEDING TEA WASTE ON MILK PRODUCTION IN COWS



DISCUSSION

DISCUSSION

Feeding of cows with agricultural by-products and industrial wastes has been receiving considerable importance in recent years. Many published reports are available on the production performance of cows fed with many unconventional feeds and fodders. The present study was undertaken to get information regarding milk production performance in cows fed with tea waste at 15 and 25 per cent level in the concentrate mixture.

The results obtained during the course of the present study are discussed below.

From the results presented in Table 7 it may appear that there was a slight reduction in the body weight of the animals when they were on diets containing either 15 or 25 per cent tea waste in the ration. But on statistical analysis of the data (Table 8) it was found that the difference in the body weight between treatments was not significant ($P > 0.05$), thereby indicating that the feed has no influence on the body weight of the animals.

It was found from the results given in Table 13 that the milk production of the cows during the first phase on diet C, A and B was 549.60, 495.50 and 526.90 kg respectively. During the second phase the total milk yield of the cows on diet C and A was almost equal ie., 506.10 and 506.60 kg respectively. But

the cows on diet B produced only 451.10 kg of milk. The cows on diet C produced a total quantity of 448.60 kg of milk during the third phase in comparison to the quantities of 392.50 and 394.80 kg obtained from cows on diet A and B respectively. The cows on diet C were found to be better in milk production during this phase of the experiment. The total milk production during all the three phases of the groups of three animals each commencing with diet C, A and B was 1393.20, 1396.40 and 1482.10 kg respectively indicating not much difference in milk production among the groups. But treatment wise the total milk production of the animals fed with diet C, A and B was 1504.30, 1394.60 and 1373.30 kg respectively. The statistical analysis of the data pertaining to milk production (Table 14) revealed that the animals on diet C gave significantly higher milk yield ($P < 0.05$) as compared to those on diet A or B. But no significant difference in the milk yield was noticed between the animals on diets A and B. However, the difference in the total milk yield due to the treatments A and C was not highly significant.

The analysis of the data presented in Table 15 with regard to the percentage of fat revealed that the average percentage of fat in the milk of cows on diets A, B and C was 4.50 ± 0.36, 4.37 ± 0.22 and 4.71 ± 0.35 respectively. This indicated that the quality of the milk with reference to the percentage of fat remained almost the same in all treatments. The analysis of variance with reference to fat percentage is given in Table 16.

The total quantity of butter fat (kg) produced by the animals on different diets is indicated in Table 17. At the end of first phase of the experiment the quantity of fat produced was found to be 26.31, 23.93 and 24.13 kg respectively for the animals fed 0, 15 and 25 per cent of tea waste in the feed. In the second phase the cows on diet C produced 23.69 kg fat as compared to 20.54 and 18.61 kg produced by those on diet A and B respectively. During the third phase the total fat production was 20.62, 18.09 and 17.09 kg for the animals fed with 0, 15 and 25 per cent tea waste respectively. The total butter fat production of the three groups of animals which started with 0, 15 and 25 per cent tea waste in the feed was 63.08, 64.69 and 65.29 kg respectively. There was not much difference among the groups for the total butter fat production when they successively underwent the three dietary treatments.

The mean butter fat production of the cows on diet C per period was 7.85 kg as compared to 6.96 kg for animals on diet A and 6.65 kg for on diet B. The total butter fat production of animals which received diet C, A and B was 70.61, 62.63 and 59.82 kg respectively. The greater quantity of butter fat produced by the animals on diet C indicated that the diet without tea waste was superior in comparison to diets containing tea wastes. Since there was no significant difference in the percentage of fat in milk due to different treatments, the increase in the total butter fat yield in control group might be due to

the increase in total milk yield. On statistical analysis (Table 18) the difference in total fat production between the animals fed no tea waste and those fed with tea waste was highly significant ($P < 0.01$). However, there was no significant difference between treatments A and B.

The quantities of four per cent fat-corrected milk yield of the cows are given in Table 19. The cows fed with diets containing 0, 15 and 25 per cent tea waste produced 614.49, 557.15 and 572.71 kg of milk respectively during the first phase of the experiment. During the second phase the total four per cent fat-corrected milk was 557.64, 510.74 and 459.59 kg for the animals fed with diet C, A and B respectively. At the end of the third phase the animals on control ration containing no tea waste produced 488.74 kg and those on 15 and 25 per cent tea waste in the diet yielded 428.20 and 414.12 kg milk on four per cent fat basis. When the animals in each group consisting of three were taken successively from treatments C, A and B to the others the total quantity of four per cent fat-corrected milk was 1502.28, 1528.91 and 1572.19 kg respectively indicating not much difference among the groups. But the treatment wise total quantity of four per cent fat-corrected milk produced during the entire period by animals fed with diet A was 1456.09 kg and it was 1446.42 and 1660.87 kg for the animals on diet B and C respectively. The mean yield was found to be 194.54, 159.57 and 160.71 kg for diets C, A and B respectively. On statistical

analysis the differences in fat-corrected milk between animals on diets C and A and also between those on diets C and B were found to be highly significant ($P < 0.01$).

The data presented in the Table 23 revealed that the animals on diet C produced 71.02 kg of total solids during the first phase of the experiment in comparison with 65.50 and 67.27 kg of total solids yielded by animals on diet A and B respectively during the same phase. During the second phase the yield of total solids was 68.10, 65.21 and 60.27 kg for animals that received diets C, A and B respectively. In the third phase cows on diet C gave 58.50 kg total solids whereas the cows on diet A and B yielded 50.58 and 52.14 kg respectively. When the groups of three animals commencing with diet treatments C, A and B during the first phase were given the other treatments in a successive manner yielded a total of 181.87, 185.74 and 188.98 kg of total solids respectively during the entire period. When the three phases were taken into consideration the animals on diet A produced 179.20 kg of total solids, whereas animals on diet B and C produced 179.68 and 197.62 kg respectively. The average total solids yield (kg) for the animals on diet C, A and B was 21.96, 19.91 and 19.96 kg respectively. The analysis of the data revealed no significant difference in the total solids yield among the three different groups of animals ($P > 0.01$). The average percentage of total solids in milk of cows due to treatments A, B and C were found

to be 12.88 ± 0.46, 13.14 ± 0.47 and 13.18 ± 0.75 respectively. The analysis of variance (Table 21) regarding the percentage of total solids revealed that there was no significant difference ($P > 0.05$) between treatments. So a slight increase in the yield of total solids in the milk of control group might be due to an increase in the total milk yield in control animals. Also quality of milk with reference to total solids percentage remained same for all treatments.

The data on the solids-not-fat content of the milk of the cows presented in Table 27 indicated that the animals on diet C produced 44.72 kg of solids-not-fat as against the quantity of 41.56 and 43.10 kg given by animals on diet A and B respectively. The production of solids-not-fat was found to be 44.72, 42.66 and 41.63 kg for animals on diets C, A and B respectively during the second phase. In the third phase the cows on diets C, A and B produced 37.89, 32.50 and 35.03 kg respectively. The groups of three animals getting the diet treatments C, A and B in the first phase when taken successively to the other treatments they produced a total of 118.85, 121.01 and 123.65 kg of solids-not-fat respectively during the entire period of the experiment. But ow treatment wise the cows on diets C, A and B produced 127.03, 116.72 and 119.76 kg of solids-not-fat in the total period of all the three phases of the experiment. The average percentage of solids-not-fat in the milk of experimental cows is given in Table 25. The average

percentage of solids-not-fat for the diets A, B and C was found to be 8.39 ± 0.36, 8.76 ± 0.51 and 8.48 ± 0.46 respectively. On statistical analysis (Table 26) the variations in percentage of solids-not-fat were found to be not significant ($P > 0.05$). The mean yield of solids-not-fat for cows that received diet C was 14.11 kg whereas that on diet A and B was 12.97 and 13.31 kg respectively. The results of the statistical analysis of the data revealed that the variation in the total yield of solids-not-fat obtained for the different diets was not significant ($P > 0.05$).

The yield of solids-corrected milk for the cows on diet C during the first phase was 575.65 kg and the yield was 529.69 and 537.90 kg for cows on diet A and B respectively. In the second phase the yield obtained was 544.70, 494.41 and 468.08 kg for the animals on diets C, A and B respectively. During the third phase the animals on diet C produced 468.45 kg of solids-corrected milk whereas animals on diet A produced 407.06 kg and those on diet B yielded 410.21 kg (Table 29). When the groups of cows were successively taken to different diet treatments total quantity of 1450.79, 1484.68 and 1500.76 kg of solids-corrected milk was obtained for the three groups of cows which were on diet treatments C, A and B respectively during the first phase. But the treatment wise total quantity of solids-corrected milk yielded by cows fed with diet C, A and B was 1588.71, 1431.16 and 1416.19 kg respectively. The average

yield of solids-corrected milk was found to be 176.52, 159.02 and 157.35 kg for the animals on diets C, A and B respectively for the experimental period. On statistical analysis of the data on solids-corrected milk it was found that the cows on diet C had significantly higher yield as compared to those on diets A and B ($P < 0.01$). It was evident from statistical analysis presented in Table 22 that the percentage of total solids in milk remained constant for all treatments. So it can be concluded that an increase in the total yield of solids-corrected milk of the cows fed no tea waste in the ration was due to an increase in the total milk yield as compared to those fed with tea waste.

The effect of feeding tea waste on the physiological status of the cows was studied by determining some of the blood values like haemoglobin content, packed cell volume and total erythrocyte count. The values obtained for RBC count (million/c.m.m), haemoglobin (g/100 ml) and packed cell volume (%) were found to be within the normal range reported for healthy cows (Pillai, 1972) thereby indicating that the experimental animals enjoyed normal physiological status similar to the cows on diet containing no tea waste.

The analysis of the data on the studies relating to physical and chemical constants of the butter fat of the cows presented in Table 35 showed no significant differences in the

values such as melting point, iodine value and saponification value. This indicated that feeding tea waste in the concentrate ration of cows had no influence on the composition of the butter fat.

From the foregoing discussions it will be seen that the cows on the control group, not getting tea waste in the ration were better milk producers ($P < 0.01$) measured in terms of total fat content, fat-corrected and solids-corrected milk as compared to those receiving tea waste in the concentrate ration. The total milk yield as well as the amount of total solids contained in the milk of the cows not getting tea waste were found to be significantly higher ($P < 0.05$). But no significant difference was noticed in the total solids-not-fat content of the milk of cows fed with or without tea waste in the ration ($P > 0.05$). However, no significant difference was noticed in the percentage of fat, solids-not-fat and total solids of the milk of cows in the control group and those getting tea waste ($P > 0.05$). This indicated that feeding of tea waste did not bring about any changes in the quality of milk. There was no significant difference in any parameters used for studying the milk production between the animals getting 15 per cent and 25 per cent tea waste in the ration.

Also there was no significant difference in body weight, the blood values and the characteristics of butter

fat between the control animals having no tea waste and those getting tea waste in the ration. This indicated that tea waste even at the level of 25 per cent in the concentrate ration when fed to cows did not produce much alteration in the physiological status of the animal.

It has been reported that some of the agricultural and industrial waste materials such as mango seed kernel, silk cotton seed cake and dried poultry litter waste could be included in the ration of dairy cows at ten per cent level without affecting the milk yield (Patel et al., 1970; Muniyappa, 1972 and Silva et al., 1976). When the percentage of dried poultry waste in the ration was increased a downward trend in the total solids, solids-not-fat and milk yield was noticed (Silva et al., 1976). Eventhough feeding tea waste at 15 per cent level in the concentrate ration for cows had indicated some reduction in the total milk yield and total solids perhaps with different combinations of conventional items of feed in the ration, the biological efficiency of the ration containing tea waste could be improved.

During the experimental phase of 23 days the average of total milk production of the cows in the control group was 167.10 kg as against a quantity of 154.90 and 152.59 kg produced by the animals getting tea waste at 15 and 25 per cent level respectively in the ration.

The average concentrate feed consumption by an animal in the control group was 111.5 kg as compared to 111.2 and 105.9 kg of concentrate feed consumed by an animal in the experimental group getting 15 and 25 per cent tea waste respectively in the concentrate ration. This showed that there was a reduction of 12.2 kg of milk per animal in the experimental group getting 15 per cent tea waste. The reduction was 14.51 kg of milk for the animal getting 25 per cent tea waste. The value of the milk that got reduced due to feeding of tea waste at 15 and 25 per cent worked out to Rs.21.35 and Rs.25.39 respectively. However, the cost of 111.5 kg of concentrate feed consumed by the control animal was 199.55 as against Rs.166.80 and Rs.144.02 for 111.2 and 105.9 kg of feed consumed by the animals getting 15 per cent and 25 per cent tea waste in the ration. There was a saving of Rs.22.79 and Rs.45.53 in the feed cost of the animals getting 15 per cent and 25 per cent tea waste respectively. If the loss due to reduction in milk yield was taken into consideration the net saving worked out to be Re.0.60 and Rs.20.14 by feeding the animal with 15 and 25 per cent tea waste respectively in the ration. Therefore it can be stated that on the basis of economics the saving in feed cost will compensate the loss due to milk production in the case of animals getting 15 per cent tea waste in the ration and the feed containing 25 per cent tea waste can be considered to be more profitable as compared to the feed containing no tea waste (Fig. 1).

SUMMARY

SUMMARY

The purpose of the present investigation was to find out the feeding value of tea waste for milk production in cows. The experiment was carried out using nine Jersey x Sindhi crossbred cows maintained at the University Livestock Farm, Mannuthy. The animals were divided into three groups of three animals each as uniformly as possible with regard to yield and stage of lactation. Tea waste was incorporated in the concentrate mixture at 0, 15 and 25 per cent levels to replace part of wheat bran. The experimental period of 90 days was divided into three, each consisting of 30 days. A switch-over design was used for the experiment.

Maize, groundnut cake and wheat bran formed the chief ingredients in the concentrate mixture used for the experiments. The animals were fed individually as per Sen and Rao Feeding Standards (1971). In addition to the concentrate mixture the animals were provided with grass silage and clean water ad libitum. The following inferences were drawn.

The feeding of tea waste at 15 or 25 per cent level in the concentrate mixture did not influence the body weight of the animals to any significant level.

With regard to milk yield the animals in the control

group having no tea waste in the concentrate mixture were found to be better milk producers in comparison to those having 15 and 25 per cent tea waste in their ration. The total milk production of the animals fed with diet C, A and B was 1504.30, 1394.60 and 1373.30 kg respectively.

The total quantity of butter fat produced by the different dietary treatments was also found to vary. The control group that received no tea waste in the ration produced significantly more butter fat than the other two experimental groups. The total butter fat production of animals which received the diet containing 0, 15 and 25 per cent levels of tea waste was 70.61, 62.63 and 59.32 kg respectively. The analysis of the data with regard to the percentage of fat revealed that there was no significant difference due to different dietary treatments. This indicated that the quality of milk with reference to the percentage of fat remained almost the same in all the treatments.

A significant difference was also noticed in four per cent fat-corrected milk yield of the cows under different dietary treatments. The control, with no tea waste in their ration produced more compared to experimental groups. The control group produced 1660.97 kg of milk as against 1436.09 and 1446.42 kg of milk given by the cows under 15 and 25 per cent tea waste respectively.

There were differences in the quantities of total solids yielded by the animals on different diets. The animals on diet C produced 197.62 kg of total solids, whereas animals on diet A and B produced 179.20 and 179.68 kg respectively. The statistical analysis of the data indicated that the differences were not highly significant. Since there was no significant difference in the percentage of total solids in the milk, the slight increase in the yield of total solids in the milk of the animals in the control group could be attributed to an increase in the total milk yield of the animals in that group.

On statistical analysis of the data on solids-corrected milk it was found that the cows on diet C produced significantly higher yield as compared to those on diets A and B. The total quantity of solids-corrected milk yielded by cows fed with diet C, A and B was 1588.71, 1431.16 and 1416.19 kg respectively. No differences was found in either solids-not-fat percentage or total solids-not-fat yield due to the experimental diets.

The physiological status of the animals fed on the ration containing tea waste as determined by the blood values like haemoglobin content, packed cell volume and total erythrocytic count was similar to that of the control animals. These values were found to be within the normal range reported for healthy cows.

No differences were noticed in some of the physical and chemical constants like melting point, iodine number and saponification number of butter fat indicating feeding of tea waste upto 25 per cent level in the concentrate ration of cows had no influence on the composition of the butter fat.

There was no significant difference in any of the parameters used for studying the milk production between the animals getting 15 per cent and 25 per cent tea waste in the ration.

Eventhough there was a slight reduction of total milk yield and total solids yield by feeding tea waste at 15 per cent level in the concentrate ration perhaps the biological efficiency of the ration containing tea waste could be improved by utilising the different conventional items of feed in different combinations.

The cost of the feed containing tea waste was found to be less as compared to that of the ration containing conventional items. It was found that on the basis of economics the saving in the feed cost will compensate the loss due to milk production in the case of animals getting 15 per cent tea waste in their ration and as compared to control ration having no tea waste the ration containing 25 per cent tea waste could be utilised more profitably for milk production

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EVALUATION OF THE FEEDING VALUE OF TEA WASTE FOR MILK PRODUCTION IN COWS

BY

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ABSTRACT OF A THESIS

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ABSTRACT

An investigation was carried out to find out the feeding value of tea waste for milk production in cows. A total of nine Jersey x Sindhi crossbred cows were divided into three groups of three animals each and fed tea waste in their concentrate ration at 0, 15 and 25 per cent levels. A switch-over design was used for the experiment.

From the results it was revealed that feeding of tea waste upto 25 per cent in the concentrate mixture has no significant influence on the body weight of the animals. It was found that the milk production of the control animals having no tea waste in their rations was found to be significantly higher as compared to that of the animals getting tea waste at 15 or 25 per cent level. Eventhough the animals of the control group produced a significantly higher yield of butter fat and total solids in milk, their respective percentage remained almost the same for all the treatments thereby indicating that the quality of milk remained unaltered. In terms of fat-corrected milk and solids-corrected milk the animals of the control group had a significantly higher yield than those of the animals in the experimental group. No significant difference was noticed in the percentage of solids-not-fat or in total solids-not-

fat yield among the three groups.

The physiological status of the cows in all the groups as revealed by the study of the blood values was normal and satisfactory.

The feeding of tea waste upto 25 per cent in the concentrate mixture did not bring about any significant difference in the physical and chemical constants of butter fat. On the basis of economics, the ration containing tea waste at 15 per cent level can be considered as equivalent to the control feed containing no tea waste and the ration having 25 per cent tea waste was found to be more profitable for milk production.