
UNIVERSITI PUTRA MALAYSIA

# *INVESTIGATING PROBLEMS IN MILK COMPOSITION AT A MILK COLLECTING CENTRE*

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# INVESTIGATING PROBLEMS IN MILK COMPOSITION AT A MILK COLLECTING CENTRE.

by

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## ABSTRACT

INVESTIGATING PROBLEMS IN MILK COMPOSITION
AT A MILK COLLECTING CENTRE.

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1989

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A study was undertaken in order to calculate the losses due to rejection of milk with low total solids and determine the causes. Monthly records, for the past three years at the Tapah Milk Collecting Centre were analysed and the losses calculated.

Ten of the farmers who sell their milk regularly to the MCC were interviewed based on the factors that may be responsible for the reduced total solids. Observations, collection of feed samples for proximate analysis and ration nutrient content calculation and also clinical diagnosis of mastitis were carried out.

The calculated losses due to milk rejection over the past three years were 53870.43 litres which was worth M$40412.82. The annual percentage of losses from 1986 to 1988 were 0.64%, 5.25% and 11.99% respectively with an

average of 5.46%. The causes identified were an inadequate daily intake of crude protein and metabolizable energy. Other causes included unequal milking intervals and the probability of sub-clinical mastitis. The effect of high ambient temperatures on voluntary feed intake claimed by majority of the farmers may also contribute to the current problem.

The Milk Collecting Centre was recommended to test milk for total solids before acceptance and also to advise and provide exposure to smallholders concerning practical ration formulation. Smallholders were also recommended to practice equal milking intervals and mastitis control programmes.

# ABSTRAK

INVESTIGATING PROBLEMS IN MILK COMPOSITION
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1989

Penyelia : Dr.Henry Too Hing Lee

Satu kajian telah pun dijalankan untuk menghitung kerugian berdasarkan penolakan susu yang rendah kandungan jumlah bahan pepejal serta mengenalpasti sebab-sebabnya. Rekod-rekod bulanan di Pusat Pengumpulan Susu, Tapah bagi tiga tahun kebelakangan telah dianalisa dan kerugian-kerugian dihitung.

Sepuluh penternak yang menjual susu mereka setiap hari kepada PPS ditemuduga berdasarkan faktor-faktor yang mungkin merendahkan jumlah bahan pepejal. Pemerhatian, pengambilan contoh bahan makanan untuk analisa proksimat dan pengiraan kandungan nutrien ransum harian dan juga diagnosa klinikal mastitis dijalankan.

Kerugian untuk tiga tahun yang lalu dianggarkan sebanyak 53870.43 liter yang bernilai M$40412.82. Peratusan kerugian tahunan dari 1986 hingga 1988 adalah 0.64%, 5.25% dan 11.99% dengan purata sebanyak 5.46%. Faktor-faktor

penyebab berkurangnya jumlah bahan pepejal yang dikenalpasti ialah pengambilan protein kasar dan tenaga ungkaibina harian yang tidak mencukupi, jarakmasa memerah yang tidak sama dan juga kebarangkalian wujudnya mastitis sub-klinikal. Kesan suhu sekitaran yang tinggi keatas pengambilan makanan secara sukarela yang dikemukakan oleh sebilangan besar penternak juga merupakan salah satu faktor penyebab.

Pusat Pengumpulan Susu disarankan supaya menguji kandungan jumlah bahan pepejal sebelum menerima susu daripada penternak dan juga memberi nasihat dan pendedahan kepada penternak-penternak mengenai formulasi ransum yang praktik. Penternak-penternak juga dinasihatkan supaya mengamalkan jarakmasa memerah yang sama dan program pengawalan mastitis.

# INTRODUCTION

Malaysia is self sufficient in eggs, poultry meat, pork and produces 45% of beef for domestic consumption. However the country depends heavily on importation of milk and milk products. While about 5.4 million litres of fresh milk were produced locally in 1982, a total of 440 million litres of liquid milk equivalent was imported in the same year. Domestic production has increased marginally from 1973 to 1980 representing only about 3 per cent of total milk consumption throughout the decade. Much attention should, therefore, be given to the Dairy Development Programme in the country (Vijchulata and Osman, 1984).

The Dairy Development Programme was initiated in 1974 with the objective to increase income of farmers and local production of fresh milk towards meeting the liquid milk market demand. The Milk Collecting Centre (MCC) is the focus of activities of the Dairy Development Programme within the Dairy Developmment Area, whereby it provides services such as breeding, extension, milk collection, cooling and processing facilities, supply of improved and productive cattle, credit facilities, supply of feeds and market for milk (Dept.of Vet.Services, 1985).

MCCs accept milk from farmers once it satisfies basic physical and chemical tests and complies with certain standards of quality (Dept.of Vet.Services, 1985). The situation is the same at Dutch Baby Milk Industries. Milk from MCCs will only be accepted after certain standards as determined by the company are met. Due to the strict terms of acceptance of milk at the factory level, there has been quite a number of rejections of a particular MCC milk due to low total solid content. Since the rejections will lead to losses, the present study was conducted in order to :-

* Determine the losses encountered by the MCC due to rejection of milk with low total solids.
* Determine the cause(s) for low total solid in milk.
* Provide recommendations to the MCC and smallholder on how to improve milk quality.

# LITERATURE REVIEW

Chemical composition determines the ultimate nutritional value of the milk for the consumer and also has a direct effect on the output of dairy products in the creamery ( Castle & Watkins,1979 ).The average composition of milk as reported in the literature, is merely the numerical average of a certain number of tests; it cannot give a true picture of the milk composition found in the city milk plants. Breed, season and other factors influence the fat and solids-non-fat (SNF) percentages of milk ( Henderson,1971 ).

The fat percentage of milk shows more variation than any other constituent.It is influenced by many factors.In general the variations in the fat content of milk are accompanied by changes in the same direction in the SNF content,but at a slower rate ( Henderson,1971 ).

Ashby and others (1977) demonstrated a relationship between bulk milk composition and cell counts; total solids, SNF and fat concentration tend to decrease as cell counts increase. This is in agreement with Hradil and Svitavsky (1967) who noted a mark drop in the SNF in milk when the cell count increased to an average of 500,000 per ml. or above. They also concluded that the major effect of mastitis is on the lactose and not the protein content.

Mastitis in both the clinical and sub-clinical forms, can drastically reduce the yield of milk and decrease the SNF content. The effect of other diseases on milk composition is not so clear, but any illness which raises the body temperature above 39 degrees C will depress milk yield and SNF content with a tendency to increase the fat content ( Castle & Watkins,1979 ).

Among climatic factors, temperature and humidity are the major components affecting milk composition. Herman (1938) regards season and temperature as largely responsible for the decline in SNF content of milk. Regan and Richardson (1938) reported a decrease of 0.7% in milk SNF, when the temperature was raised from 4.4 to 35 degrees C. Their experiments also support the idea that the change in humidity is more important than temperature.

King (1980) stated that udder pressure is a factor which reduces fat content and therefore longer milking intervals overnight will produce milk lower in fat compared to evening milk. He also concluded that feeding can influence the fat content and therefore the total solid content of milk is within the limit of a cows inherited fat production capacity.

One of the most marked changes in milk composition due to diet is its effect on fat content, which is termed the `low fat syndrome'. Milk fat is highest when fermentation

in the rumen favours the production of acetate. Diets which depress acetate will depress milk fat content ( Castle and Watkins,1979 ). According to Ashwood and Ross (1985), composition levels below the minimum requirements are most common in underfed stock. They also suggested that low quality or amount of pasture may depress fat levels, and that insufficient energy and protein intake will depress fat and SNF contents of milk.

## MATERIALS AND METHODS

The study was conducted at the Tapah Milk Collecting Centre (MCC), in the Batang Padang District, Perak. The approximate distance covered was 60 km.

The MCC records were studied. Annual sales and rejection of milk by Dutch Baby Milk Industries (DBMI) for the past three years were calculated. Total losses in terms of litres and ringgit were estimated by multiplying the annual amount rejected by $0.75; that is the price paid for every litre of milk by the Federal Agricultural Marketing Authority.

Ten smallholders were chosen out of thirty active members of the MCC by means of a stratified random sampling technique. Five areas were chosen within this district. From each of the five lists, two smallholders were randomly chosen.

Each of the smallholders were visited and interviewed with the aid of a prepared structured questionnaire (refer appendix IV). Farm activities were also observed. Data collected was based on factors which may be responsible for low total solids in milk. This included information concerning breeds of cattle, average liveweight daily milk

production, feeding and milking practices, incidence of mastitis and climatic factors. Methods for diagnosis of clinical mastitis were based on physical examination of udders and visual inspection of the milk.

Feed samples were collected whenever possible from a number of farms and sent to the Veterinary Research Institute, Ipoh for proximate analysis. An estimation of daily dry matter (DM) and nutrient intake was made by adding up crude protein (CP), crude fiber (CF), ether extract (EE), metabolizable energy (ME) and DM content of feeds incorporated into the daily ration. The results were compared to standard recommended values.

## RESULTS

Table 1 shows annual sales and losses of the MCC due to milk rejection at DBMI for the past three years. The total amount of milk rejected over the past three years in litres and ringgit were 53870.43 l and $40412.82 respectively, thus comprising 5.46 per cent of the total milk sent to the factory.

The chemical composition of forages and concentrates incorporated into daily rations of the farms investigated is shown in Appendix II. The farms under investigation had a total of ninety three cows in lactation, which were predominantly LID crosses and Friesian-Sahiwal; the number of cows in individual farms varied between 2 and 25 (Table 2).

The average liveweight of lactating animals was 346 kg with an average daily milk production of 9.5 kg. The estimated DM intake of grazed grasses and stall fed concentrates were 9.5 and 3.46 kg/day respectively; thus giving a total of 12.96 kg/DM/day which was calculated to be 3.75 per cent of the average liveweight (Table 2).

Data concerning the nutrient contents of rations fed to lactating cows is shown in Table 3. These figures

TABLE 1. ANNUAL SALES AND LOSSES DUE TO MILK REJECTION AT DBMI.

| YEAR | SENT | REJECTED | | |
|---|---|---|---|---|
| | (litres) | (litres) | M$ | % of total |
| 1986 | 341011.69 | 2188.35 | 1641.26 | 0.64 |
| 1987 | 380734.63 | 19992.05 | 14994.04 | 5.25 |
| *1988 | 264254.70 | 31690.03 | 23777.52 | 11.99 |
| TOTAL | 986001.02 | 53870.43 | 40412.82 | 5.46 |

* Until October 1988.

TABLE 2. DAILY DRY MATTER (DM) INTAKE OF LACTATING COWS AT VARIOUS FARMS.

| FARM | NO. OF LACTATING COWS | Av.LW (kg) | Av.DMP (kg) | DMI (kg/anim/day) | |
|---|---|---|---|---|---|
| | | | | Stall fed | Grazing* |
| F1 | 8 | 340 | 10 | 1.65 | 8.5 |
| F2 | 25 | 400 | 12 | 1.13 | 11.2 |
| F3 | 2 | 300 | 4 | 0.81 | 7.9 |
| F4 | 11 | 350 | 10 | 6.00 | 9.7 |
| F5 | 4 | 380 | 12 | 3.45 | 10.7 |
| F6 | 7 | 400 | 15 | 5.13 | 11.5 |
| F7 | 10 | 300 | 7 | 2.42 | 8.2 |
| F8 | 7 | 300 | 7 | 6.08 | 8.2 |
| F9 | 10 | 370 | 10 | 4.34 | 10.2 |
| F10 | 9 | 320 | 8 | 3.58 | 8.8 |
| MEAN | 9.3 | 346 | 9.5 | 3.46 | 9.5 |

* Estimated by the formula:- DMI(kg/day) = 0.025W + 0.1Y
W = Liveweight (kg)
Y = Daily Milk Production (kg)

Av.LW = Average Liveweight.
Av.DMP = Average Daily Milk Production.

TABLE 3. AVERAGE DAILY NUTRIENT CONTENT OF RATIONS FOR LACTATING COWS AT VARIOUS FARMS

| FARM | DM BASIS | | | | |
|---|---|---|---|---|---|
| | DM% | CP% | CF% | EE% | ME(Mcal/kg) |
| FI | 32.91 | 7.60 | 22.14 | 1.98 | 2.06 |
| F2 | 30.29 | 10.50 | 28.35 | 1.58 | 2.19 |
| * F3 | 81.50 | 9.82 | 7.36 | 1.05 | 2.32 |
| F4 | 29.70 | 10.33 | 18.75 | 3.11 | 2.18 |
| * F5 | 85.69 | 9.92 | 7.59 | 1.39 | 2.63 |
| * F6 | 51.31 | 16.29 | 16.15 | 5.18 | 2.35 |
| F7 | 20.44 | 10.37 | 28.50 | 1.63 | 2.23 |
| F8 | 35.83 | 11.39 | 21.96 | 1.66 | 2.12 |
| F9 | 33.96 | 9.95 | 22.81 | 1.55 | 2.17 |
| * F10 | 23.08 | 9.50 | 16.40 | 1.72 | 2.30 |
| MEAN | 42.47 | 10.57 | 19.00 | 2.08 | 2.25 |

* Nutrients from grass grazed not included.

represent the total percentage after adding up total nutrient contents of all feeds incorporated into the daily ration.

The average time intervals from morning-to-evening and evening-to-following morning milkings were 9.0 and 15.0 hours respectively (Table 4). The average percentage of acute and chronic mastitis amongst all herds studied were 10.35 and 13.96 per cent respectively (Table 5). Only one out of ten smallholders interviewed practiced teat dipping with iodine.

Data concerning the effect of climatic factors were based on the smallholders impression that high ambient temperatures and wet seasons reduced voluntary feed intake and predisposed their animals to fever.

TABLE 4. MILKING TIMES AND INTERVALS AT VARIOUS FARMS.

| FARM | MORNING (M) (a.m) | EVENING (E) (p.m) | INTERVALS (HRS) (M)-(E) | (E)-(M) |
|---|---|---|---|---|
| F1 | 6.00 | 5.00 | 11.0 | 13.0 |
| F2 | 5.30 | 3.00 | 9.5 | 14.5 |
| F3 | 7.00 | 4.00 | 9.0 | 15.0 |
| F4 | 5.00 | 1.00 | 8.0 | 16.0 |
| F5 | 6.30 | 1.00 | 6.5 | 17.5 |
| F6 | 7.00 | 4.30 | 9.5 | 14.5 |
| F7 | 5.30 | 4.30 | 11.0 | 13.0 |
| F8 | 5.30 | 3.00 | 9.5 | 14.5 |
| F9 | 7.00 | 2.00 | 7.0 | 17.0 |
| F10 | 5.30 | 3.00 | 9.5 | 14.5 |
| MEAN | 6.00 | 3.00 | 9.0 | 15.0 |

TABLE 5. CASES OF MASTITIS AT VARIOUS FARMS. .
( 9th Nov. - 9th Dec. 1988 )

| FARM | NO. OF LACTATING ANIMALS | MASTITIS | | | |
|---|---|---|---|---|---|
| | | ACUTE | | CHRONIC | |
| | | NO. | % | NO. | |
| F1 | 8 | 1 | 12.5 | 2 | 25.0 |
| F2 | 25 | 3 | 12.0 | 1 | 4.0 |
| F3 | 2 | 0 | 0.0 | 0 | 0.0 |
| F4 | 11 | 2 | 18.2 | 1 | 9.1 |
| F5 | 4 | 0 | 0.0 | 1 | 25.0 |
| F6 | 7 | 2 | 28.6 | 0 | 0.0 |
| F7 | 10 | 1 | 10.0 | 2 | 20.0 |
| F8 | 7 | 0 | 0.0 | 1 | 14.3 |
| F9 | 10 | 0 | 0.0 | 2 | 20.0 |
| F10 | 9 | 2 | 22.2 | 2 | 22.2 |
| MEAN | 9.3 | 1.1 | 10.35 | 1.2 | 13.96 |

## DISCUSSION

Table 1. shows an increase in losses encountered by the MCC due to rejection of milk sent to DBMI. From 1986 to 1988, rejections in terms of percentage have drastically increased from 0.64% to 11.99% of total milk delivered. This indicates that there is an increase in rejection over the past three years which implies an ongoing unsolved problem concerning milk quality in terms of total solids.

The total average DM intake, 12.96 kg/day which was found to be 3.75 per cent of the average liveweight (346 kg), was considered sufficient to meet the cows requirements ( Devendra, 1973 ). However the average CP content of rations which was found to be 10.57 per cent, was considered to be inadequate for lactating cows (refer appendix I). Ashwood and Ross in 1985 claimed that feeds deficient in protein reduce milk and fat yield. Underfeeding by more than 20% CP can cause the milk protein content to drop substantially. In this study, the average CP content of rations was 24.5% below the recommended CP content of the ration, which is 14% CP for cows below 400 kg and producing 8 t0 13 kg of milk per day (refer appendix I).

The average ME content of rations was found to be 2.25 Mcal/kg, which was also inadequate (refer appendix I). In general, it appears that ME intake is the main factor controlling the protein and SNF level in milk (Castle and Watkins, 1979). According to Ashwood and Ross in 1985, underfeeding of energy is the main cause of low protein levels. Continued underfeeding of energy causes milk fat percentage to drop through lost bodyweight.

According to McDonald et al in 1981, limitation of energy has a greater effect than that of protein on the SNF content of milk, although the protein fraction are reduced in both cases. He also concluded that the lowered protein content is probably due mainly to increased gluconeogenesis from amino acids, owing to a reduced propionate supply or the low energy diet. As a result, the supply of amino acids to the mammary gland is reduced and so is protein synthesis. It is also conceivable that the low energy supply limits microbial protein synthesis in the rumen and thus the amino acids available to the mammary gland.

Stobbs and Thompson in 1978 stated that in the face of inadequate dietary energy, cows obtain energy from the catabolism of body reserves. From this study there seems to be a correlation between the above statement and the

results of this study, since, apart from inadequate ME and CP levels in daily rations, the cows, on average, were in poor body condition. This could be due to catabolism of body reserves as mentioned earlier.

Other nutrients of the daily ration were above the recommended content. The CF content (19%) is 11.7 per cent above the recommended value, therefore, depression of rumenal acetate production which predisposes a "low fat syndrome" is not likely to occur. Based on these results, it is conclusive to say, that adequate nutrient intake does not depend on DM intake and therefore, a need for evaluation of feedstuff composition is essential in determining rations for lactating dairy cattle.

The average milking intervals of 9 and 15 hours also contribute to the reduction in total solids by reducing the fat content of morning milk. Due to the fact that 80 per cent of the smallholders interviewed claimed that most milk sold to the MCC was morning milk, therefore, the long night interval of 15 hours is one of the major factors contributing to low total solids, as identified in this study. According to Castle and Watkins in 1979, with milking intervals of 9 and 15 hours, the difference in fat contents can be of 1 per cent. King, in 1980, concluded

that udder pressure is the factor that caused this variation in fat content. A longer night interval will increase udder pressure due to more milk contained. Herrington, in 1948, stated that some factors could be operating at night that favour the secretion of increased volumes of low-test milk. He also concluded that after long night intervals, the concentration of lactose, casein and fat decreases with an increase in globulin, chlorides and ash. It is suggested that the unequal milking intervals practiced by the smallholders has reduced milk total solids as concluded by the above workers.

The average percentage of animals suffering from acute and chronic mastitis was 10.35% and 13.96% respectively. Although milk was not tested for sub-clinical mastitis, nevertheless, due to the above results and the fact that only one of the smallholders practiced teat disinfection and not any of them practiced a routine mastitis control programme, it is reasonable to assume that there is a probability of sub-clinical mastitis within the herds investigated.

Foley and others in 1972 concluded that approximately 12 per cent of all cows produce abnormal milk at any given time, and at least 50 per cent of the cows in the U.S are

infected with pathogenic bacteria in two or more quarters. Since no mastitis control programme was practiced by the smallholders and due to the fact that the smallholders level of management is either the same or lower compared to U.S. dairy farmers, therefore, the above figures would probably be the same or even higher in our local cows. King in 1980 stated that sub-clinical mastitis is more important than the clinical form since milk from the affected quarters has a slightly lowered fat content but appears normal macroscopically and thus is often included in the general milk supply. This statement proves true in this study since all cows under study were not tested for sub-clinical mastitis, therefore, the milk produced would appear normal grossly and be accepted by the MCC.

The high ambient temperatures claimed by a majority of the smallholders may also contribute to the current problem since these factors have been known to reduce fat and SNF contents. Temperatures consistently higher than 30 degrees C progressively reduce feed intake, milk yield, SNF and protein (Ashwood and Ross, 1985). King , in 1980, stated that a low fat content occured during a period of continuous heat.

## CONCLUSION

Variation in milk composition is a complex situation which is governed by various factors constantly interacting with each another. However, through this study, various factors have been identified which caused milk from a number of smallholders to have low total solid content; the pooling of their milk with other nonaffected milk in the MCC bulk tank caused good quality milk to be rejected.

The losses have increased dramatically within the past three years to a sum of M$40412.82. Since the operation of the Tapah MCC and smallholder dairy management is basically the same as other areas in the country, extrapolation of the current problem and its losses nationwide, means that an enormous amount of local milk is literally being poured down the drain purely due to inadequate total solid contents, not to mention the amount of milk rejected based on the alcohol test.

From this study, it appears that the decline in milk total solids is influenced to some degree by one or more of the following factors :-

* Inadequate protein and energy intake,
* Inappropriate milking intervals,

* The probability of a certain degree of sub-clinical mastitis,
* Reduction in voluntary feed intake due to high ambient temperatures claimed by the majority of smallholders.

## RECOMMENDATION

It is recommended that the MCC includes the total solid test as one of the terms for acceptance of milk. If this is not possible, the MCC should at least set a standard value for the specific gravity test which will correlate with the minimum value of total solids accepted by DBMI.

A majority of smallholders obviously have limited knowledge concerning ration formulation and also do not realize the importance of equal milking intervals and the severe effects of mastitis. Since one of the objectives of the MCC is to aid smallholders in obtaining maximum production by providing advice and subsidization, therefore, the MCC is also recommended to advise smallholders on ration formulation and to obtain regular proximate analysis of their feeds. The importance of equal milking intervals and mastitis control programmes should also be included in the advice.

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## APPENDIX I

### RECOMMENDED NUTRIENT CONTENT OF RATIONS FOR LACTATING DAIRY CATTLE

| | COW WT. (kg) | DAILY MILK YIELDS (kg) | | | |
|---|---|---|---|---|---|
| NUTRIENTS (Conc.in the feed DM) | <400<br>500<br>600<br>>700 | <8<br><11<br><14<br><18 | 8-13<br>11-17<br>14-21<br>18-26 | 13-18<br>17-23<br>21-29<br>26-35 | >18<br>>23<br>>29<br>>35 |
| RATION NO. | | I | II | III | IV |
| Crude Protein % | | 13.0 | 14.0 | 15.0 | 16.0 |
| Metabolizable Energy (Mcal/kg) | | 2.36 | 2.53 | 2.71 | 2.89 |
| Crude Fiber % | | 17 | 17 | 17 | 17 |
| Acid Detergent Fiber % | | 21 | 21 | 21 | 21 |
| Ether Extract % | | 2 | 2 | 2 | 2 |
| Calcium % | | 0.43 | 0.48 | 0.54 | 0.60 |
| Phosphorus % | | 0.31 | 0.34 | 0.38 | 0.40 |
| Vit.A (IU/kg) | | 3200 | 3200 | 3200 | 3200 |
| Vit.D (IU/kg) | | 300 | 300 | 300 | 300 |

Source; Nutrient Requirements of Dairy Cattle, National Research Council, Washington D.C. 1978.

## APPENDIX II

### PROXIMATE ANALYSIS OF FEEDS INCORPORATED INTO THE DAILY RATION OF THE TEN FARMS VISITED.

| NO. | FEED | DRY MATTER BASIS | | | |
|---|---|---|---|---|---|
| | | CP% | CF% | EE% | ME(Mcal/kg) |
| | **CONCENTRATES** | | | | |
| 1. | BREWERS GRAIN | 91.50 | 16.40 | 15.60 | 5.70 | 2.52 |
| 2. | CASSAVA CHIPS | 28.38 | 1.57 | 13.90 | 0.32 | 2.83 |
| 3. | DAIRY CATTLE PELLET (DCP) | 89.23 | 18.96 | 6.53 | 8.57 | 2.32 |
| 4. | MAIZE (GROUND) | 86.60 | 10.90 | 2.20 | 4.20 | 2.97 |
| 5. | MOLLASES | 75.50 | 1.60 | | | 2.70 |
| 6. | PALM KERNAL CAKE (PKC) | 88.48 | 16.90 | 13.65 | 2.78 | 2.01 |
| 7. | PALM OIL SLUDGE (POS) | 92.65 | 14.53 | 11.41 | 15.42 | 2.02 |
| 8. | RICE BRAN | 88.10 | 12.67 | 21.20 | 2.18 | 1.96 |
| 9. | RICE (GROUND) | 85.60 | 9.30 | 5.50 | 1.20 | 2.64 |
| 10. | SAGO REFUSE | 17.87 | 1.57 | 9.53 | 0.38 | 2.97 |
| 11. | SOYA BEAN REFUSE | 15.28 | 23.42 | 10.94 | 7.01 | 1.96 |
| 12. | WHEAT BRAN | 86.00 | 12.00 | 14.00 | 2.00 | 2.62 |
| | **GRASSES** | | | | |
| 13. | B. DECUMBENS | 22.20 | 13.20 | 27.90 | 2.30 | 2.27 |
| 14. | B.MUTICA | 24.40 | 12.60 | 21.20 | 2.19 | 2.16 |
| 15. | LOCAL GRASS F1 | 30.00 | 6.45 | 23.81 | 1.05 | 2.02 |
| 16. | LOCAL GRASS F2 | 28.93 | 9.77 | 30.23 | 1.33 | 2.18 |
| 17. | LOCAL GRASS F4 | 26.30 | 7.17 | 24.17 | 1.67 | 2.07 |
| 18. | LOCAL GRASS F7 | 27.23 | 10.37 | 28.50 | 1.63 | 2.23 |
| 19. | LOCAL GRASS F8 | 27.47 | 9.80 | 23.70 | 1.17 | 2.21 |
| 20. | LOCAL GRASS F9 | 26.97 | 8.30 | 26.63 | 1.23 | 2.09 |
| 21. | P. PURPUREUM | 14.09 | 7.95 | 26.59 | 1.69 | 2.02 |

## APPENDIX III

### GRADING SCHEME FOR MILK TOTAL SOLIDS AT DUTCH BABY MILK INDUSTRIES.

| GRADE | PER CENT TOTAL SOLIDS |
|---|---|
| A | 13 and above |
| B | 12.50 - 12.99 |
| C | 12.00 - 12.49 |
| D | 11.50 - 11.99 |
| E (Rejected) | 11.49 and below |

## APPENDIX IV

## SURVEY QUESTIONNAIRE

**Date:**

**Farm no.:**

**Name:**

**Breeds:**

**Herd structure:**

1. **Lactating:**
2. **Pregnant:**
3. **Dry:**
4. **Heifers:**
5. **Yearling males:**
6. **Female calves:**
7. **Male calves:**
8. **Bulls:**

**Average liveweight of lactating cows:**

### FEEDING SYSTEM

**System?**

1. **Grazing only (Y/N):**
2. **Grazing with supplements (Y/N):**

**Feeds given (state):**

**Are feeds processed (Y/N):**

**If yes, what form?**

Source of feeds (state):

Are feeds stored (Y/N):

If yes, where and for how long?

Quantity of feed(s) given (lactating cow/day):

What is the stocking rate for grazing animals:

MILKING SYSTEM

Hand or machine milked :

No.of milkings per day :

Specific milking times :

Average daily milk prod./cow :

Average lactation period :

BREEDING SYSTEM

Average age at 1st calving :

Artificial or natural mating :

Breed of sire :

Average calving-to-conception period :

How many conceive at 1st service :

How many services have been made in this year :

How many have conceived in the past year :

How many calves born in the past year :

How many were weaned in the past year :

## DISEASE CONTROL SYSTEM

Practice a disease control programme (Y/N) :

If yes, state :

1.Vaccinations :

2.Deworming :

3.Deticking :

4.CMT

5.Teat disinfection :

6.Others (state) :

Encounter cases of mastitis (Y/N) :

If yes, is treatment initiated (Y/N) :

If yes, is it effective (Y/N) :

If no, why ?

No.of cows with acute mastitis :

No.of cows with chronic mastitis :

What other diseases are commonly encountered :

## ENVIRONMENTAL FACTORS

Have your animals been subjected to high temperatures or/and wet spells throughout the past year (state) :

Has these adverse conditions affected your animals in any way (Y/N) :

If yes, state :