*GAU. Res. J.* 1978. (1): 40-44

# Estimation of Protein with Help of Fat per cent in Milk of Kankrej Cows*

**G. B. Patel and S. H. Vyas**

Department of Dairy Technology, Gujarat Agricultural University, Anand Campus, Anand.

**ABSTRACT**

**Two hundred and sixty samples of milk from nine individual cows as well as forty six composite herd samples along with one hundred and thirty seven random samples of milk totaling four hundred and forty three were analysed for fat and protein content. It was observed that the increase in protein content was associated with the increase in fat, but not at a constant rate. The coefficient of correlation r = 0·7204 was calculated which was significant at 0·01 level. The 'r' values 0·742 and 0·370 were also calculated for random milk samples and herd milk samples which were significant at 0·01% and 00·5% level of significance, respectively. A formula to estimate protein content of milk from the fat content of milk was also derived.**

*(Received on March 15, '77)*

## INTRODUCTION

THE importance of the non-fat milk solids especially protein in the economy of the dairy industry has made necessary to have a quick and economical method for determining protein and S.N.F. in milk in as much time as required to determine fat content of milk. Since there is quantitative relationship between milk fat and protein of milk, it was found interesting to study this relationship.

Formulae for calculating the percentage of protein, solids not fat, total solids and casein in milk by knowing the fat per cent of milk have been studied. Different equations to compute the interrelationship between the fat and protein content of milk have been suggested which gave reliable estimates of milk protein only when applied to data from which they were derived. Many researchers have suggested either constants or/and corrections along with the basic equations in order to make the computed value a reliable one, but divergencies in the calculated values have caused confusion and doubt concerning the fundamental reliability of the method. Comprehensive reviews and studies of various formulae and techniques are available and few of the well accepted formulae are given below:

Overman (1939) $P = 1{\cdot}93 + 0{\cdot}42\ F$.

Van Slyke (1945) $P = 0{\cdot}4\ (F-3) + 2{\cdot}8$.

Berge (1963) $P = 0{\cdot}5\ F + 1{\cdot}5$.

Singh *et al* (1961) $P = 2{\cdot}96 + 0{\cdot}19\ F$ (Murrah Buffalo)

Singh *et al* (1961) $P = 2{\cdot}10 + 0{\cdot}47\ F$ (Shahiwal Cow)

Where P = % Protein in milk.

F = % Fat in milk.

From the formulae given above it can be seen that protein content of milk

* Part of M. Sc. (Agri.) thesis subsmitted by first author to Sardar Patel University (1965).

can be known directly by knowing the fat content of milk. It can be also observed that different formulae have been given by different research workers from various countries for different breeds. Limited amount of work has been done in India to know the protein content of cow's milk by knowing the fat content of milk. With the idea to find out the diversity and similarity as well as to apply the given formulae for Kankrej cow's milk and to derive a formulae which can be applicable to Kankrej cow's milk with the help of studies already made by foreign workers and Indian workers, the present study was undertaken.

## MATERIALS AND METHODS

Four hundred and forty three samples of Kankrej cow milk were analysed for fat and protein content, these samples were secured from Sheth Mungalal Narmal Goenka Institute of Animal Genetics and Animal Breeding located at the then Institute of Agriculture, Anand.

Proteins were determined by Kjeldahl's method (AOAC 1960) and results were expressed as percentage of protein. (Nitrogen × 6·38).

Standard Gerber method was followed to estimate fat per cent of milk.

Few factors like (i) effect of individuality of cows, (ii) effect of stage of lactation (iii) effect of time of milking and (iv) effect of yield of milk were studied, however, the results of these factors will be reported in another paper.

## RESULTS AND DISCUSSION

The maximum, minimum and average values for the fat and protein content observed in the milk of the experimental cows during their lactation as well as herd milk samples and samples taken at random are presented in Table 1.

*TABLE* 1

**Table showing the maximum, minimum and average values of the fat and protein in the milk of Kankrej cows.**

| *Milk Constituents* | | *Experimental cows* | *Herd milk sample* | *Random milk sample* |
|---|---|---|---|---|
| Fat% | Maximum | 7·60 | 5·70 | 10·5 |
| | Minimum | 1·45 | 3·60 | 2·70 |
| | Average | 4·73 | 4·66 | 4·74 |
| Protein % | Maximum | 4·81 | 3·60 | 5·14 |
| | Minimum | 2·49 | 2·84 | 2·71 |
| | Average | 3·31 | 3·18 | 3·30 |

It can be observed that the fat content varied from 1·45 per cent to 7·6 per cent in the milk of experimental animals while the fat contents of 2·70 to 10·5% were recorded for the samples selected at random however the average values were 4·73, 4·66 and 4·74 per cent for experimental, herd and random milk samples respectively. Though the maximum fat content was 5·2 times the minimum value, most of the other results are nearer to the average fat content of 4·73 per cent. The average value for the herd milk sample is 4·66 per cent which is quite close to that for the experimental cows.

It is probable that the random sample which showed 10·6 per cent fat might be from a cow which might be in advanced lactation or a cow about to go dry.

*Protein content in the milk of Kankrej cows:*

The protein content varied from 2·49 per cent to 4·81 per cent with the average of 3·31 per cent. Though the maximum protein content is 1·96 times the minimum value, most of the other results are not too high, not too low, as compared to the average protein content of 3·31 per cent and has the same value for the random milk samples.

The fat and protein content of herd milk samples are slightly lower than that of average milk samples drawn from individual animals.

*Correlation between fat and protein content in the milk of Kankrej cows:*

After analysing 443 milk samples of Kankrej cow, it has been observed that the increase in protein content is associated with the increase in fat content; but not at a constant rate, which is in agreement with the results obtained by Musrave and Salisbury (1952), Janse (1953), Kiermair and Rennar (1961), Erb *et al* (1963) and Kapusta (1964).

The coefficient of correlation 0·7204 was calculated, which was highly significant. This value is quite close to the value $0{\cdot}7051 \pm 0{\cdot}0161$ obtained by Cersovasky (1962). This indicates that production of both fat and protein content may be governed by similar gene or genes as stated by Johnson (1957). This type of highly significant correlation is of utmost importance for improving both fat and protein content of milk at the same time.

Though the correlation is highly significant, the increase in protein content is not linear to fat content. The rate of increase in protein content changes at different levels of fat instead of steady increase. These results suggest that the level of protein might be independent to fat to some extent.

*Applicability of different formulae for calculating the protein content of the milk from Kankrej cows:*

Various formulae for calculating protein content of milk from the fat content of milk have been proposed and used. The applicability of these formulae have been studied by many workers in different parts of the world for milk having a wide range of fat and protein contents. The "closeness of fit" for these formulae with the estimated results depends upon the constancy of the fat and protein content in milk. Variation in these constituents of milk caused by different factors may cause an appreciable difference between the calculated and the estimated values.

When the formula $P = (F-3)\ 0{\cdot}4 + 2{\cdot}8$ suggested by Van Slyke (1945) was applied to the samples of Kankrej cow's milk a higher value than the estimated was obtained though the formula was applicable to 37·5 per cent of the samples while the rest of the observation showed deviation more than 0·15 plus or minus. It has been observed that formula $P = 2{\cdot}1 + 0{\cdot}346 \pm 0{\cdot}08$ proposed by Gaines and Davidson (1938) gave on an average 0·5 per cent higher value of protein. Similarly higher estimated value was also observed when the original formula

*TABLE* 2

**Table showing the "closeness of fit" of different formulae.**

| % *Fat in sample* | *No. of sample* | *Overman (1939) (modified)* $P = 1{\cdot}43 + 0{\cdot}42F$ | | *Van Slyke (1908)* $P = 2{\cdot}8 + (F-3)\ 0.4$ | | *Lonka (1955)* $P = 1{\cdot}55 + 0{\cdot}39F$ | | *Derived by the author for Kankrej cows* $P = 1{\cdot}76 + 0{\cdot}3F$ | |
|---|---|---|---|---|---|---|---|---|---|
| | | *Samples* | % | *Samples* | % | *Samples* | % | *Samples* | % |
| From 0·0 — 10·5 | 443 | 178 | 40·5 | 188 | 37·5 | 200 | 45·2 | 223 | 50·3 |
| ,, 0·0 — 5·5 | 356 | 167 | 47·0 | 154 | 43·2 | 189 | 53·0 | 201 | 58·0 |
| ,, 3·0 — 5·5 | 312 | 146 | 47·6 | 139 | 42·0 | 152 | 49·0 | 159 | 50·9 |

$P = 0{\cdot}42\ P + 1{\cdot}93$ of Overman (1939) was applied to the present observations. However, the modified formula of Overman (1939) $P = 0{\cdot}42\ F + 1{\cdot}43 \pm 0{\cdot}15$ was applicable to 40·5 per cent of the samples.

When the protein content was calculated by the formula of Lonka (1947) i.e. $y = 1{\cdot}53 + 0{\cdot}39x \pm 0{\cdot}15$ where $y$ = protein and $x$ = fat per cent and was compared with the estimated protein content of sample; it was observed that 200 samples out of 443 (45·2%) were having indentical estimated and calculated values. The formula $P = 1{\cdot}597 + \text{Fat} \times 04{\cdot}446$ proposed by Julskjar (1958) was found to give higher calculated value and it was applicable to only 25 per cent of the total samples. While the formula $P = 0{\cdot}5\ F + 1{\cdot}5$ proposed by Berge (1963) was applied to the present observations the formula gave on an average 0·09 per cent more protein content for each per cent of fat. Moreover the difference between the calculated and estimated amount of protein became smaller when fat per cent of sample was more than 5·0 per cent. Further it can be stated from the present study that protein content of samples having more than 5·0 per cent fat was more than that of Norwagian cows and also the proportion between fat and protein was more in the samples having less than 5·0 per cent fat compared to Norwagian cows and hence the formula is not applicable to the milk of Kankrej cows.

The formula $P = 0{\cdot}19\ F + 2{\cdot}96$ proposed by Singh *et al* (1961) for the milk of Murrah buffalo was applied to the milk of Kankrej cows; it gave 0·18 — 0·21 per cent more protein value for every one per cent of fat. Similarly the formula $P = 0{\cdot}5555 + 1{\cdot}0638\ F$ proposed by Vanschoubroke (1963); when applied to the milk samples from Kankrej cows; gave much more higher value to the extent of 0·15% more protein for each per cent of fat than the estimated one. Also the recent formula recommended by Stones *et al* (1964) $T.P. = 0{\cdot}37\ F + 1{\cdot}86$ was tried and similar trends of higher estimated protein than the actual protein was noticed.

From these observations a conclusion can be drawn that all these formulae gave higher protein content than estimated ones. The probable cause may

be the low protein content of milk of Kankrej cow in proportion to fat content. Due to the high fat content in milk of Kankrej breed than most of the foreign breeds of cows; the formulae gave more protein content because the above formulae are derived from the samples having low fat content.

Though the protein content increases with the increased fat but the rate of increase of protein is considerably less at high fat value. As the fat content varied from 1·75 to 7·6 per cent; though majority of the samples falling within the fat per cent of 3·00 to 5·50; it is difficult to propose a single formula which might be applicable for all the samples to calculate correct protein content from the fat content of the sample.

However, attempts have been made by using various combinations with the help of statistical analysis to suggest a formula for Kankrej cow's milk. From the present study a new formula $P = 0{\cdot}3\ F + 1{\cdot}76 \pm 0{\cdot}15$ has been derived in Table 2 which have been found to be applicable to almost fifty per cent of the samples.

## REFERENCES


American Public Health Association, Inc. 1970. Standard methods for examination of dairy pro ducts, micro-biological and chemical. 11th Edition. Broadway, New York-19.

Berge, S. 1963. Relation between milk protein and fat contents in milk of different domestic animals. Acta Agri. Secondi XIII. 2.

Cersovsky, H. 1962. Relationships between the butterfat and protein content of cow's milk. *Dairy Sci. Abst.* **24:** 316.

Erb, R. E., U. S. Ashworth, L. J. Manus and N. S. Golding. 1963. Estimating solids-not-fat and protein in milk from different sources using percentage fat, protein and solids-not-fat. *J. Dairy Sci.* **46:** 1217.

Gaines, W. L. and O. R. Overman 1939. Interrelation of milk-fat, milk protein and milk energy-yield. *J. Dairy Sci.* **21:** 261.

Janse, L. C. 1953. The composition of Freision milk. *Netherlands Milk and Dairy J.* **7:** 199.

Johnson, K. R. 1957. Heritability, genetic and phenotypic correlations of certain constituents of cow's milk. *J. Dairy Sci.* **40:** 723.

Julskjar, O. 1958. Investigation on different methods of protein determination in milk. *Dairy Sci. Abst.* **20:** 260.

Kapusta, 1964. Protein in relation to the butterfat content in milk and its economical significance in the dairy industry. *Dairy Sci. Abst.* **26:** 444.

Kiermeir, P. and A. Probst. 1962. Genetic effects on the milk protein content in the Weihenstephan A.I and milk receiving area. *Dairy. Sci. Abst.* **24:** 346.

Lonka, T. 1947. Can the relation between fat and protein in milk be changed by selective breeding. *Dairy Sci. Abst.* **13:** 252.

Musrave, S. D. and G. W. Salisbury. 1952. The relationship of milk energy and total protein to per cent fat in brown Swiss herd milk. *J. Dairy Sci.* **35:** 174.

Overman, O. R. 1939. Composition of Brown Swiss Cow milk *Agri. Expt. Stat. Bull.* 457.

Singh, R.P.M. Singh, V. S. Rao and S. N. Singh. 1961. Quantitative relations among the milk constituents. I. Effect of breed, stage of lactation and age of animal. *Indian J. Dairy Sci.* **14:** 119.

Stones, W. K., M. C. Connor and N. R. Thomson. 1964. Amounts, variations and interrelation of the major milk components in individual farm deliveries. *J. Dairy Sci.* **47:** 502

Vanschoabroek, F.X.E.J. 1963. Determination and variation of protein, fat and lactose in cows milk and selection of these factors. *Nether Milk* and *Dairy J.* **17:** 12.