

## INHERITANCE OF THRESHOLD CHARACTERS IN ZEBU CATTLE

Hérédité des caractères pathologiques ches le zebu

Herencia de los caracteres patológicos en el cebú

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Resistance and susceptibility are manifestations of interactions of host and pathogen metabolism and of its genotype and environment. Disease resistance in animals will continue to be of specific significance to the future dairy cattle breeder for genetic application in high producing milch animals.

One of the important factors interfering with attempts to augment animal production in India is the occurrence of diseases. Prevalence of mastitis is highly important in dairy cattle. Similarly the disfunction of the ovaries is probably one of the common causes of infertility and sterility affecting the high producing dairy cattle.

The present studies were undertaken with a view to investigate the incidence and inheritance of disease resistance with particular emphasis on potential role of applied genetics in the prevention of mastitis and cystic degeneration of ovary in three Indian dairy breeds: Tharparkar, Sahiwal and Red Sindhi.

### MATERIAL AND METHODS

The investigation was conducted in the herds maintained at National Dairy Research Institute, Karnal, its Regional Station at Bangalore and Central Cattle Breeding Farm (Suratgarh). All the heifers above 2 years of age and the adult females were examined for incidence of cystic degeneration of the ovary and all cows in 1 to 7 months lactation stage were screened for incidence of subclinical mastitis. The cows were hand milked, the animals were washed before milking, the udders were also wiped with a towel dipped in mild antiseptic solution before

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milking. 20 ml of milk samples from each quarter were collected aseptically and S. L. S. T. test (PENDSE, 1966), leucocyte count (as per the procedure of ISI, 1960) and HOTIS test (MERCHANT and PACKER, 1952) were conducted for determining susceptible cases.

Besides this, data on clinical incidence of mastitis for Karnal herd as recorded for the period 1970 to 1972 were utilized for the study. The heritability of clinical mastitis was estimated by the method given by LUSH (1950).

*t* test was applied to find the significance of differences in the estimated milk production ability (EPA) between groups of cows with cystic degeneration of ovary and those without.

The EPA was calculated according to the formula given by LUSH (1945). The repeatability for this purpose was taken as 0.50. Only the production records of normal lactations between 100 and 305 days were considered.

Chi-square tests were employed to test the differences between groups of cows with and without incidence of clinical and sub-clinical mastitis and differences between the incidences of cystic degeneration of ovary during early (first lactation or earlier) and later stades of production (second and subsequent lactations).

## RESULTS AND DISCUSSIONS

### *Mastitis*

#### Incidence

Table I summarises data on the incidence of sub-clinical mastitis. The incidence was highest in Sahiwal herd followed by the Tharparkar herds at Karnal and Suratgarh and lastly by the Red Sindhi herd.

Maximum incidence of clinical mastitis was recorded in the Sahiwal (51.33 %) followed by the Tharparkar (46.10 %) and the Red Sindhi (34.28 %) in herds of 150, 190 and 70 animals screened respectively. The incidence for clinical mastitis studied by KRUGER (1953) in case of Schleswig Holstein breed, LEGOSIN (1966) in Dutch Friesian and Jersey breeds, MARIC and ILLANCIC (1968) in case of Black pied and Simmental breed, ranged from 20 to 60 percent. They have also reported that there were variations in incidence from breed to breed. The results of the present investigation are in accordance with the findings of these workers.

#### Heritability of clinical mastitis

Data on the incidence of clinical mastitis among daughters of dams susceptible or not have been presented in Table II together with the estimates of heritability. The values of heritability observed by GAUNYA (1961) for Jersey cows, LEGATES and GRINNELLS (1952) in case of North Carolina Dairy herds, LEGOSIN (1966) for Dutch Friesian and Jersey breeds, LUSH (1950) for New Zealand dairy herds (mostly Jersey), RENDEL and SUNDBERG (1962) for Swedish cattle, PROBST *et al.* (1968) for Spotted Mountain, Brown Mountain, Red Danish, Angeln and Black Pied breeds, SCHMIDT and VAN VLECK (1965) for Holstein cows and YOUNG *et al.*

(1959) for Ayrshire, Guernsey, Holstein and Jersey breeds were in the range of 0.13 to 0.73. No heritability estimates for incidence of mastitis have yet been reported for any Zebu breeds. The estimates reported herein agree with the reports cited above.

#### Milk production ability of cows with sub-clinical mastitis

The average EPA of cows susceptible and non-susceptible for sub-clinical mastitis were 1989.00 and 1968.00 Kg for Tharparkar herd 2225.30 and 2163.00 Kg for Sahiwal herd and 2212.41 and 1956.33 Kg for Red Sindhi herd. The differences were not significant statistically. The results obtained in the present investigation agree with the findings of LEGATES and GRINNELLS (1952).

#### *Cystic degeneration of ovary*

##### Incidence in different breeds

The data on the incidence of cystic degeneration of ovary in different farms in the three breeds studied have been presented in Table III. The incidence in these breeds have not been reported earlier. The statistical analysis revealed that the differences in incidence between the breeds were significant. ROBERTS (1955) and SVENSK (1961) estimated the incidence in case of Holstein-Friesian as 58.60 percent, in Guernseys as 33.62 percent and in Ayrshire as 5.62 percent. LUKTUK and ARORA (1967) reported the incidence in case of Harijana breed as 2.00 percent.

TABLE 3  
INCIDENCE OF CYSTIC DEGENERATION OF OVARY IN COWS

| Farm                              | Breed      | Number of animals screened | Number found with cystic ovary | Percentage |
|-----------------------------------|------------|----------------------------|--------------------------------|------------|
| N. D. R. I., Karnal               | Tharparkar | 183                        | 20                             | 10.92      |
| N. D. R. I., Karnal               | Sahiwal    | 150                        | 3                              | 2.00       |
| N. D. R. I., Karnal               | Red Sindhi | 70                         | 2                              | 2.86       |
| S. R. S. of N. D. R. I. Bangalore | Tharparkar | 74                         | 7                              | 9.45       |
| C. C. B. F., Suratgarh            | Tharparkar | 123                        | 12                             | 9.75       |

The data were classified into two groups, «Early» and «Late», depending on the age of the animal screened. It was observed that the incidence was significantly higher ( $P < 0.01$ ) in case of «Early» group than in the «Late» group (Table IV). This finding agreed with the observations of ROBERTS (1955) on Holstein-Friesian and Guernsey cows and HENRICSON (1956) on Swedish Red and white cows.

TABLE 1  
INCIDENCE OF SUB-CLINICAL MASTITIS IN DIFFERENT HERDS

| Farm      | Breed      | No. of cows screened | S. L. S. T. Test |            | Hotis Test      |            | Leucocyte Count |            |
|-----------|------------|----------------------|------------------|------------|-----------------|------------|-----------------|------------|
|           |            |                      | Number positive  | Percentage | Number positive | Percentage | Number positive | Percentage |
| Suratgarh | Tharparkar | 70                   | 35               | 50.00      | 45              | 64.28      | 42              | 60.00      |
| Karnal    | Tharparkar | 120                  | 65               | 54.16      | 72              | 60.00      | 80              | 66.66      |
| Karnal    | Sahiwal    | 100                  | 58               | 58.00      | 64              | 64.00      | 70              | 70.00      |
| Karnal    | Red Sindhi | 35                   | 16               | 45.71      | 17              | 48.57      | 18              | 51.42      |

TABLE 2  
INCIDENCE AND INHERITANCE OF CLINICAL MASTITIS

| Breed      | Dams Susceptible      |                     |            | Dams Resistant        |                     |            | Estimate of heritability |
|------------|-----------------------|---------------------|------------|-----------------------|---------------------|------------|--------------------------|
|            | Daughters susceptible | Daughters resistant | Percentage | Daughters susceptible | Daughters resistant | Percentage |                          |
| Tharparkar | 38                    | 24                  | 61.29      | 25                    | 53                  | 32.00      | 0.584                    |
| Sahiwal    | 38                    | 18                  | 67.85      | 21                    | 43                  | 35.00      | 0.656                    |
| Red Sindhi | 9                     | 9                   | 50.00      | 6                     | 26                  | 18.75      | 0.626                    |

TABLE 4

INCIDENCE OF CYSTIC DEGENERATION OF OVARY IN DIFFERENT AGE GROUP

| Breed      | EARLY                      |                                     |            | LATE                       |                                     |            |
|------------|----------------------------|-------------------------------------|------------|----------------------------|-------------------------------------|------------|
|            | Number of animals screened | Number of animals with cystic ovary | Percentage | Number of animals screened | Number of animals with cystic ovary | Percentage |
| Tharparkar | 125                        | 22                                  | 17.60      | 248                        |                                     | 8.06       |
| Sahiwal    | 90                         | 2                                   | 22.22      | 60                         |                                     | 16.66      |
| Red Sindhi | 20                         | 2                                   | 10.00      | 30                         |                                     | 0.00       |

## Incidence in different lactations

In the Table V data have been presented on the incidence of cystic degeneration of ovary in different lactations and the average age of the defective cows. This study was confined to Tharparkar breed only as adequate number of observations were available in that breed. The probability of occurrence of the defect was quite high upto 5th lactation or average age of 11.30 years. The same was found to be low during 2nd lactation or at the average age of 6.60 years. The number of observations being few, the present study only gives a trend of incidence. No other reports are available on the probability of occurrence according to lactation or age in Zebu breeds. HENRICSON (1956) reported that the average frequency of cystic degeneration of ovary was 0.16 at a mean age of 4.45 years while cumulative risk of the diseases reached a frequency of 0.49 at about 10.50 years of age and a frequency of 0.58 at 11-12 years in case of Swedish Red and White cows. ROBERTS (1955) also observed that the incidence of cystic degeneration of ovary in case of Holstein-Friesian and Guernsey cows was highest in cows aged 5 to 6 years.

The average EPA of defective Tharparkar cows was 2031.75 Kg and of normal cows 1900.00 Kg. The difference between the groups was not statistically signifi-

TABLE 5

INCIDENCE OF CYSTIC DEGENERATION OF OVARY IN DIFFERENT LACTATION IN THARPARKAR BREED

|   | LACTATIONS |      |      |      |      |       |      |
|---|------------|------|------|------|------|-------|------|
|   | Heifer     | 1    | 2    | 3    | 4    | 5     | 6    |
| Number of heifers/cows examined ... ..                                      | 26         | 40   | 43   | 17   | 12   | 10    | 7    |
| Number of cases with cystic degeneration of ovary ... ..                    | 6          | 12   | 4    | 6    | 3    | 5     | 0    |
| Probability of occurrence of cystic ovary.                                  | 0.23       | 0.30 | 0.09 | 0.35 | 0.25 | 0.50  | 0.00 |
| Average age of the animals with cystic degeneration of ovary (years) ... .. | 4.31       | 5.82 | 6.60 | 7.50 | 8.26 | 11.30 | —    |

cant. These findings are in accordance with those of HENRICSON (1956) in case of Swedish Red and white cows and KOCH and BERGER (1954) in case of Small Spotted Mountain Cattle.

### SUMMARY

From the present study it could be concluded that daughter and dam do resemble each other in susceptibility to mastitis and culling of the most affected should lessen the incidence and severity of mastitis. In effecting selection for disease resistance we should concentrate more on sire lines while paying attention to the production characters simultaneously. It is not impossible to develop strains among the breeds for resistance to incidence of mastitis and cystic degeneration of ovary. Development of such resistant strains will minimise economic losses due to such diseases and will contribute to overall profitability of the dairy enterprise.

### RESUME

On peut déduire de cette étude que les filles et les se ressemblent entre elles quant à la susceptibilité à la mastite, et que le rebut des plus affectées diminuerait la fréquence et sévérité de la dite maladie.

Pour réaliser la sélection en cherchant la résistance à la mastite on devrait concentrer un peu plus notre attention sur les lignes paternes, et en même temps tenir compte des caractères de production. Il n'est pas impossible d'obtenir des souches dans les races, plus résistantes à la fréquence de la mastite et à la dégénération kystique d'ovaires. Le développement de telles souches résistants diminuera au minimum les pertes économiques et contribuera à obtenir des résultats positifs de l'entreprise laitière.

### RESUMEN

Del presente estudio puede deducirse que hijas y madres se parecen entre sí en cuanto a la susceptibilidad a la mastitis, y que el desecho de las más afectadas disminuiría la frecuencia y severidad de dicha enfermedad. Para realizar la selección buscando la resistencia a la mastitis se debería concentrar más la atención en las líneas paternas, al mismo tiempo que se tienen en cuenta los caracteres de producción. No es imposible obtener estirpes dentro de las razas, más resistentes a la frecuencia de la mastitis y a la degeneración quística ovárica. El desarrollo de tales estirpes resistentes disminuirá al mínimo las pérdidas económicas y contribuirá a obtener resultados positivos de la empresa lechera.

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