DEVELOPMENT OF THE CARORA BREED

F. Cerutti¹, J.C. Alvarez², R. Rizzi¹

¹ Dept VSA, University of Milan, Italy
² As. Criadores de Ganado Carora, Carora, Edo Lara, Venezuela

INTRODUCTION

Origin of the breed  The Carora dairy cattle was officially recognised in 1982. The Breeder Association ASOCRICA (Asociación de Criadores de la Raza Carora) was created in 1979. It is a synthetic breed developed in the Central Western Venezuela by using Brown Swiss semen on the local Criollo population (Ganado Criollo de Quebrada Arriba). This process started in the thirties of the last century, with semen firstly coming from Europe and North America and later by using crossbred bulls to avoid to loose adaptation to the tropical environment. In addition, most probably natural selection favoured specific Criollo genes, such as slick hair gene (Olson, 2003) and specific phenogroups (Ceriotti et al., 1994). In the ’80s many farmers changed their activity towards other agricultural products such as the sugar cane, resulting in a severe decrease of Carora herds and in some cases into their dispersal in areas other than their place of origin.

Production systems  Carora cattle are bred in a tropical environment with a large range of average temperatures from 22 to 38 C° and with humidity up to 90%. Carora cows are reared under different production systems, from extensive systems, characterised by grazing and manual milking in the presence of the calf, to intensive systems with high yields, machine milking and concentrate supplementation. Since 1995 Carora bulls are used in Holstein herds to obtain a productive animal adapted to tropical climate. In addition, Carora bulls are today mated to Bos indicus cows with the aim of obtaining “doble proposito” animals.

In 1992 ASOCRICA with the support of the University of Milan started a long-term program on the breed. This paper summarizes the activities developed in the last fifteen years, including the re-organisation of the Breeder’s Association, the technical support to the breed management and selection, and the current management scheme.

RE-ORGANIZATION OF THE BREEDERS’ ASSOCIATION

The following activities, as propedeutical to the long term program, were carried out.

Association aims  The organization of the Breeders Association was modified from a corporative association into a technical Breeders Association oriented to breed selection and to provide services to farmers.

Animals’ identification  This was an essential step in order to warrant accuracy and efficiency of tracing the movement of livestock. The animals are identified by a tattoo code including herd code, animal code and birth year, respectively. An additional within-herd id is used, that can be merged to the main code automatically.

Database - historical information  Historical information were collected, edited and organized in a new database. Table 1 reports number and type of information available in the breed database.
Table 1. Number and type of records in Carora database.

<table>
<thead>
<tr>
<th>Type of records</th>
<th>2004</th>
<th>2005</th>
<th>Variation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedigree records</td>
<td>93,277</td>
<td>104,253</td>
<td>11.77%</td>
</tr>
<tr>
<td>Lactations</td>
<td>177,75</td>
<td>187,782</td>
<td>5.64%</td>
</tr>
<tr>
<td>Test day measurements</td>
<td>951,84</td>
<td>1,032,186</td>
<td>8.44%</td>
</tr>
<tr>
<td>Services</td>
<td>203,85</td>
<td>226,357</td>
<td>11.04%</td>
</tr>
<tr>
<td>Pregnancy diagnoses</td>
<td>178,02</td>
<td>202,126</td>
<td>13.54%</td>
</tr>
<tr>
<td>Weights</td>
<td>69,728</td>
<td>112,107</td>
<td>60.78%</td>
</tr>
<tr>
<td>Tick resistance evaluations</td>
<td>1,959</td>
<td>1,959</td>
<td>0.00%</td>
</tr>
<tr>
<td>Type traits evaluations</td>
<td>5,171</td>
<td>5,217</td>
<td>0.89%</td>
</tr>
<tr>
<td>Rectal temperature records</td>
<td>12,053</td>
<td>12,053</td>
<td>0.00%</td>
</tr>
<tr>
<td>Parentage controls</td>
<td>474</td>
<td>474</td>
<td>0.00%</td>
</tr>
<tr>
<td>Milk content measurements</td>
<td>191,32</td>
<td>223,44</td>
<td>16.79%</td>
</tr>
</tbody>
</table>

**Information management**  The Breeders Association equipped itself of a computer service to manage the breed database and to provide services to farmers. Farmers equipped with own computer system can retrieve information from the central database by Internet. **Herdbook:** adoption of criteria  with the aim to increase breed size, the Breeders Association adopted a herdbook including crossbred animals pooled in three sections on the basis of percentage of Carora genes (1/2, 3/4, 7/8). Animals with proportion of Carora inheritance up to 93.75% and with a close Carora type are included in the herdbook of the Carora purebreds.

**TECHNICAL SUPPORT TO SELECTION**

**Genetic and phenotypic parameters:** Genetic parameters were estimated for total and 305-d milk yield and for type traits by using an animal model. The heritability values were 0.17 and 0.22 for total and 305-d milk yield, respectively (Cerutti et al., 1994). These estimates were in the range reported by Lobo et al (2000) for dairy cattle in tropical environment. In a previous research on Carora (Morales et al., 1989) heritability of milk in first lactation was 0.12 based on 44 Carora sires with 14 daughters per sire. The repeatabilities for total and 305-d milk yield were 0.36 and 0.38, respectively. These values were close to those reported for purebred Boran, Friesian and their crosses in Ethiopia (Demeke et al., 2004) and for Carora (Morales et al., 1989). As regards the type traits the highest and lowest heritability values were found for stature (0.47) and foot angle (0.03) respectively (Riera Nieves, personal communication). The heritability values for type were in agreement with those reported for Holsteins in Mexico (Navarrete and Ruiz Lopez, 1998) and slightly lower than those reported in literature for cows in temperate countries (Short and Lawlor, 1992; Brotherstone, 1994; De Groot et al., 2002).

**Growth curve:** Considering that crossbreeding between Carora and *Bos indicus* breeds is used in ‘doble proposito’ herds, growth precocity is an important goal in selection. Multiplicative coefficients were calculated both to adjust body weight at 12, 18, 24 36 months and to adjust age for 250, 300, 350 and 400 kg body weight in order to evaluate the animals for growth and precocity. The adjustments coefficients were computed from the solutions of age from a mixed animal model (Caroli et al., 1997).

**Projected lactations:** This tool was adopted to anticipate the genetic evaluation of Carora bulls for 305-d milk yield. The milk yield is estimated by means the test interval method from at least 3 test day measurements carried out by the technicians of ASOCRICA. Multiplicative coefficients were calculated in order to obtain projected milk yields from information on partial lactations (Cerutti et al., 1995).
Slick hair gene: Some studies demonstrated that the ability to maintain low body temperature in hot environment is associated to sleek, dense coats in cattle. Evidence was found that supports the existence of a major gene (*slick hair* gene), dominant in mode of inheritance, that is responsible for producing the short, sleek hair coat (Olson et al., 2003). The evaluation of bull progeny for hair length was introduced in 2004 on the basis a subjective visual scoring system as reported in Olson et al., (2003). Today bulls identified as heterozygous on the basis of the phenotype of their sons are culled.

Staybility Herdlife, productive life and number of calvings were higher in Carora cows than in Holsteins cows. Lifetime performances of Carora cows decreased over the 1961-1986 time period whereas the productive ones increased (Rizzi et al., 2002).

Inbreeding control: An increase of 1.5% of inbreeding from 1984 to 1994 was observed. Inbreeding control strategy was then adopted (see ‘Current management program’ section).

Tick resistance This trait is important for ‘doble proposito’ animals, In Carora tick resistance showed good variability (Cerutti et al., 1995) and tick fertility was significantly higher in Holstein bulls (Melendez et al, 1998). Some trials were successfully carried out to verify the application of two methods for measuring tick resistance (ticks fertility and experimental infestation with *Bos microplus* larvae on the bulls). However, the practical application is not currently carried out, because farmers prefer to use the chemical control.

Milk quality In 1998 a laboratory was installed to analyze milk sample of cows. At the present milk protein yield relative to 10,270 lactations of 5,252 cows are available for estimating genetic parameters and breeding values. In Carora an average milk protein content of 3.73% was found (Brenci et al., 2001). Studies are in progress in order to replace genetic evaluations of 305-d milk yield with genetic evaluations for milk protein yield per day of calving interval.

CURRENT MANAGEMENT PROGRAM

Selection goals The main selection aim was increasing milk production in terms of quantity and quality. A second objective was uniformity of morphology to breed standards, considering that several crosses type were included in the herdbook. Improvement of udder and legs was considered important by farmers; however, since the accuracy of aggregate indices for milk and type traits was low, selection for type traits was excluded. It was planned to include in the near future genetic indexes for the average milk yield per calving interval will be also estimated in order to account for fertility. Particular attention was given to improve reliability of genetic evaluations in the tropical farming conditions.

Selection scheme Since all farmers participating to the project use extensively AI, the selection of AI bulls and criteria of collection, storage and distribution of semen are directly managed by the Breeders Association. Farmers are free in the choice of natural service bulls, Since data bank contains all information relative to pregnancy, the Breeders Association select the calves by optimizing pedigree index and relationships coefficients by means of the Minbreed program (Gandini and De Filippi, 1998); every six months, the number of calves for progeny test is 2.5 times the number of AI bulls. Up to 30% of young bulls may be sons of unproven progeny testing bulls. The Breeders Associations recommends the use of young bulls on 60-70% of cow population. Bulls are progeny tested with at least 15 daughters in 4 herds, In order to facilitate bulls turnover and inbreeding control at the beginning the Breeders Association decided to eliminate bulls after the production of 3250 doses of semen (1000 for progeny tests, 1000 for sale and 1000 for the sale after the publication of the indexes, 250 for semen bank). Currently, these criteria are less severe due to increasing request of Carora semen
from herds not participant to the program. The farmers are inclined to use the unproven bulls’ semen, since the Breeders Association recommends the use of young bull for a percentage of 60-70%. Every six months, for each cow to inseminate the Breeders Association recommends each herd a set of bulls on the basis of both genetic index and mating relationship.

**ECONOMIC ASPECTS**

The program was developed by the Breeders Association by means of its own ordinary resources and of with some co-funding from the Venezuelan government in years 1993-1996, for a total of 155,145 USS. In addition, some farmers gave 87,230 USS as additional contribution in the same period. The Italian Latin American Institute (IILA) has contributed with the donation of computational equipments and a milk laboratory with a spectrophotometer. The University of Milan financed some researches, Currently, the program is financed with incomes from services to the breeders and from semen sale.

The Breeders Association is the owner of AI bulls recognizing to the farmers only the value of carcass at slaughter and a percentage (10%) from the semen sale.

**Genetic Centre:** For the raising and training of young bulls, collection, storage and distribution of semen, the Breeders Association use an AI centre that currently works only for the Carora. There is a plan that this centre may change into a co-operative of farmers participating to the program.

**Dissemination** Particular attention was given to disseminate the results of the program and the research activity, both at the local, national and international levels. This includes the Breeders Association journal, that also presents results of genetic evaluations and guideline on the use of these results. Moreover, a WEB site ([www.razacarora.com](http://www.razacarora.com)) is active.

**PROGRAM RESULTS**

**Number of animals and breeders involved** At the start of the project (1992) three farmers and about 1000 cows were involved. Currently, more than 2500 purebred, 2800 upgraded cows and 70 herds are taking part to the project and are under control of the Breeders Association.

**Genetic trend** The annual EBV averages representing the genetic trends are depicted in figure 1. The genetic trend for milk yield increased steadily over the years. The trend line indicates that the estimated genetic gain is 35 kg from 1991, when the genetic improvement program started, to 2001.

![Figure 1. Genetic trend of milk for the Carora breed,](image)
**Prediction of bull’s evaluation** Genetic merit of bulls is increased during the development of the program and is generally higher than the corresponding genetic merit of young bulls from pedigree information (Table 2).

Table 2. Average pedigree index and EBV of bulls for each birth year.

<table>
<thead>
<tr>
<th>Bull birth year</th>
<th>Average Pedigree index</th>
<th>Average EBV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>244</td>
<td>472</td>
</tr>
<tr>
<td>1993</td>
<td>368</td>
<td>627</td>
</tr>
<tr>
<td>1994</td>
<td>324</td>
<td>277</td>
</tr>
<tr>
<td>1995</td>
<td>355</td>
<td>489</td>
</tr>
<tr>
<td>1996</td>
<td>562</td>
<td>615</td>
</tr>
<tr>
<td>1997</td>
<td>614</td>
<td>792</td>
</tr>
</tbody>
</table>

**Carora semen demand** In the last years the breeders of ‘doble proposito’ animals have requested consistent quantity of semen of Carora bulls in order to increase the performances in milk production and to warrant the adaptation to climate.

**Economic value of animals** Today in Venezuela there is very high demand of Carora cows and their price is the highest among dairy cattle.

**FUTURE UTILIZATION OF THE BREED**

**Purebred animals** The Carora breed may be important for milk production in tropical environment due to its adaptation and productivity. **Crossbred animals in ‘doble proposito’ herds** All productive and reproductive information are being collected to compare all F1 and backcrosses between Carora and Bos indicus breeds and to evaluate the best crossing strategy.

**Crossbred animals for high production** At the present the experiences indicate that the crossbreeding with Carora breed may improve the adaptation of the Holstein breed. Since in Carora x Holstein crosses the production appears equal or best than in purebred Holstein animals, the most convenient crossing possibilities are been evaluating.

**REFERENCES**