

## REALIZED SELECTION RESPONSE IN DECENTRALIZED MOET BREEDING PROGRAM TO INCREASE PROTEIN TO FAT RATIO

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### SUMMARY

In 1990 the organizations responsible for Finnish dairy breeding and milk marketing established an open nucleus breeding program called ASMO. The aim of the ASMO project is to raise the protein to fat ratio in milk with simultaneously increasing the protein production. Base donors were selected from the Ayrshire population and since 1993 also from the Friesian population in milk recording. A multitrait selection index based on the animal model BLUP evaluation of protein and fat contents and protein yield was used. Selection of base donor cows continued till 1994. Altogether 424 flushings from 278 cows have yielded 1,169 transferable embryos. Pregnancy rates of 60.02 % have been achieved with fresh embryos and of 44.82 % with frozen embryos. The total amount of 487 calves has been born. The estimated genetic merit of the first generation ayrshire calves is this far 13.5 kg for protein yield (from 214 kg in the national breed average to 227 kg) +0.15 % for protein content (3.28 % → 3.43 %) and -0.12 % for fat content (4.46 % → 4.34 %). In 1994 the offspring from 1990 selected animals will have their first six months' lactation records and first AM-BLUP evaluations.

### INTRODUCTION

Surplus of milk products and especially the surplus of butterfat has during the last 20 years been a large problem to Finnish agriculture. Recent trends in consumption of dairy products, consumers preferring low fat products to butter fat, have made the surplus of butter fat a permanent state of affairs. In 1992 the protein to fat ratio in the milk of Finnish Ayrshire was as low as 0.74, and in the milk of Finnish Friesian 0.78 (table 1) when the dairy industry would prefer a ratio of one.

Table 1. Results from milk recording in 1992 for Finnish Ayrshire, Finnish Friesian and Finncattle (Anon 1993)

Breed	No of cows	Milk kg	Fat kg	Fat %	Protein kg	Protein %	Protein /Fat
Ayrshire	215025	6506	290	4.46	214	3.28	0.74
Friesian	52372	6705	277	4.13	215	3.20	0.78
Finncattle	2396	5454	246	4.51	185	3.38	0.75

The basic idea of nucleus breeding program using MOET was introduced by Nicholas and Smith in 1983. They showed the advantage of MOET schemes, juvenile and adult, over traditional progeny testing programs by using deterministic methods. Later on several researchers found that the response in milk yield was over estimated in Nicholas and Smith (1983) calculations, but that the response in MOET scheme is about the same than in well operated progeny testing scheme (Juga and Mäki-Tanila 1987, Meuwissen 1989, Ruane and Thompson 1991). Many

modifications to Nicholas and Smith (1983) schemes have been introduced, considering alternative mating designs (Woolliams 1989, Ruane 1991, Strandén et al. 1991) and open nucleus herds (Colleau 1986). The factorial mating design, with more than one male mated to a female, have proved to be superior to the hierarchical design without increasing inbreeding rates. A further reduction in inbreeding has been shown to be achievable by using more than one bull per selected sibship (Woolliams 1989, Ruane 1991, Strandén et al. 1991). Strandén et al. (1991) also pointed out that MOET schemes are more promising with traits with high heritability. Some large scale MOET schemes in dairy cattle e.g. the Genus herd in England (McGuirk 1990) and an experimental MOET herd in The National Institute of Animal Science in Denmark (Liboriussen and Christensen 1990) have already been implemented.

To change the protein to fat ratio to be more preferable, and to decrease the butterfat overproduction Agricultural Research Centre ARC, Finnish Animal Breeding Association FABA, Valio co-operative Dairies' Association and the Ministry of Agriculture and Forestry established an open MOET nucleus breeding program called ASMO. A decentralized strategy, in which cows are owned by the commercial farmers, and flushings and embryo transfers are carried out on farms, was chosen to minimize costs and to avoid disease risk. As an experimental MOET scheme ASMO project investigates the selection response in nucleus breeding scheme and monitors problems in running a large scale nucleus breeding program.

### MATERIALS AND METHODS

Selection of base donor cows and bulls started in the autumn of 1990. The selection concerned only Finnish Ayrshire breed. In the beginning of 1993 the project was enlarged to Finnish Friesian breed to utilize the genetic lift experienced with Ayrshire breed in changing the protein to fat ratio and to serve enthusiastic Finnish Friesian breeders. The selection is based on the national breeding value indices calculated with animal model BLUP. An ASMO-index is calculated to cows and bulls as follows:

$$I_{\text{cow}} = 1.0 * (\text{protein\%-index} - 100) - 0.6 * (\text{fat\%-index} - 100) + 0.4 * (\text{protein yield index} - 100)$$

and

$$I_{\text{bull}} = 0.7 * (\text{protein\%-index} - 100) - 0.4 * (\text{fat\%-index} - 100) + 0.5 * \text{TMI},$$

where TMI in the national total merit index of bulls. The weights in the index are chosen to provide equal progress (relative to genetic variance) in protein yield and percentage, while keeping the fat percentage constant or slightly decrease it. In the national AI-breeding program the main emphasis is on increasing protein yield and decreasing fat content.

Cows having  $I_{\text{cow}}$  at least 21 and high enough ( $\approx 7500$  kg) milk yields are checked for conformation by FABA field representatives. Mating plans for chosen animals are done centrally using three different bulls for a donor. The donors are flushed and the embryo transfers are carried out on farms by four veterinarians. Fresh embryos are transferred to recipients on the same or neighbouring farms and frozen embryos are sold with nominal price to the other farmers. Farmers buying embryos have to agree of the future use of offspring in ASMO project. Direct cost of flushings and a reward for flushings are paid to the farmer by the project. The original aim was to produce eight offspring per base donor. This would require approximately 12 embryos per donor, and three flushings per cow.

### RESULTS

At the end of 1993 the total number of base donors in ASMO project was 311, of which 286 were Finnish Ayrshires and 25 were Friesians. As base sires 29 Ayrshire and 11

Friesian bulls were used with matings. Out of 11 Friesian bulls 2 were of foreign origin. The protein to fat ratio of selected Ayrshire donor cows has been 0.83 with 3.53 % of protein and 4.23 % of fat. In Finnish Friesian the same ratio was 0.94 with 3.44 % of protein and 3.63 % of fat. More statistics of donor cows are given in table 2.

**Table 2.** Average production records, and AM-BLUP indices for milk traits (mean 100, s.d 10) of cows and bulls accepted to ASMO project.

		No	Milk kg	Protein kg	Protein %	Fat %
Ayrshire cows:	Record	286	8093	285	3.53	4.23
	Index	286	104.6	113.8	111.6	96.4
Ayrshire bulls:	Index	29	101.7	112.3	113.9	98.5
Friesian cows:	Record	25	8990	312	3.44	3.63
	Index	25	113.8	123.2	111.7	92.4
Friesian bulls:	Index	9	104.7	113.9	113.4	96.6

The total amount of flushings till the end of 1993 was 424 (table 3). In 38 cases (not included in 424 flushings) the donor did not respond to the super ovulation treatment. On average 6.04 embryos have been recovered per flush of which 3.94 have been transferable. The variation in the number of embryos per flush has ranged from 0 to 35. In 60 flushings (14.2 % of all flushings) the number of embryos was 0. The number of transferable embryos per flush varied from 0 to 25, and in 123 flushings (29.0 % of all flushings) the number of transferable embryos recovered was 0.

**Table 3.** Results from flushings in ASMO project.

	No of flushes	No of embryos total	/flush	Accepted embryos total	/flush	Frozen embryos
1st flush	278	1685	6.06	1124	4.04	624
2nd flush	118	698	5.92	415	3.52	243
3rd flush	28	180	6.43	130	4.64	103
Total	424	2563	6.04	1669	3.94	970

The number of accepted embryos per donor have been 6.0 and the number of flushings per donor is 1.52. The results from flushings have improved considerably during the project. Number of embryos per flush has increased from 5.1 to 6.5 and the number of transferable embryos per flush from 2.5 to 4.6. The total number of transfers with fresh embryos till the end of 1993 was 699 with an average pregnancy rate of 60.02 %, and the total number of transfers with frozen embryos was 628 with an average pregnancy rate of 44.82 %. By the end of 1993 we have the information of 487 calves born of which 209 are females and 265 are males. Out of 265 male calves 55 have been sold to AI-co-operatives to be performance tested. Out of 36 already tested bulls 15 have passed the performance test and are used as young bulls.

The estimated genetic merit of the first generation ayrshire calves is this far 13.5 kg for protein yield (from 214 kg in the national breed average to 227 kg), +0.15 % for protein content (3.28 % → 3.43 %) and -0.12 % for fat content (4.46 % → 4.34 %). The average breeding values for accepted Ayrshire embryos, ASMO bull calves sold to AI and Ayrshire bull calves from AI-breeding program born in 1993 are presented in table 4.

**Table 4.** Average pedigree indices (mean 100, s.d 10) of recovered Ayrshire embryos, ASMO bull calves sold to AI and Ayrshire bull calves from national AI-breeding program.

	No	Milk kg	Protein kg	Protein %	Fat %
Pedigree index	1513	104.0	113.0	110.8	95.9
ASMO bull calves to AI	55	108.5	117.6	108.8	94.8
All AI bull calves	150	116.5	119.5	99.0	90.0

In the year 1994 about 45 - 50 offspring from 1990 and 1991 selected animals will have their first six months' lactation records, and first AM-BLUP evaluations. Thus the selection of second generation can start. Also the selection of second generation ASMO-cows will be based on ASMO-index calculated from national breeding value indices.

### DISCUSSION

The ASMO project was implemented to change the protein to fat ratio by increasing the protein content. The results show that the program has fulfilled the original aim, the predicted genetic superiority in the first generation Ayrshire calves being +13.5 kg, +0.15 % and -0.12 % in protein yield, protein percentage and in fat percentage. Also the protein to fat ratio of selected Ayrshire cows is 0.83 and 0.94 with selected Friesian cows, compared to 0.74 and 0.78 in the milk of Finnish Ayrshire and Finnish Friesian.

The most severe problem in running decentralized open nucleus scheme is the low number of flushings per cow. The plan was to flush every donor three times, but only 28 donors out of 278 cows have been flushed three times. About 52 % of all donors never had their second flushing and about 74 % of those who had been flushed twice gave up before third flushing. The main reason for the low number of flushings per cow is the farmers' unwillingness to risk the calving interval.

The intention was to flush 100 base donor cows a year to produce eight offspring each. In the end of 1993 the number of flushings per donor was 1.52 and the number of accepted embryos per donor were 6.0. The variability in the number of embryos recovered per flush due to the different response to super ovulation causes a considerable reduction in selection response. Hence more research in the physiology of embryo transfer is required.

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