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ABSTRACT

Rabbit production in Uruguay is not consolidated, showing episodic cycles of expansion and retraction. The consumption of rabbit meat is negligible (less than 100 g per capita/year), while total meat consumption exceeds 99 kg per capita. Notwithstanding, rabbit production is considered a promising alternative, taking in consideration the potential demand of the regional common market (MERCOSUR) and the existence of favorable conditions for competitiveness (health status, climatic conditions, infrastructure, availability of foodstuffs). The rabbit breeding stock has been estimated in about 8.000 does. The production sector is composed of approximately 250 rabbit farms, prevailing small-scale family units, with an average farm size ranging 20-30 breeding does. The majority of rabbit farms are diversified combining other economic activities with rabbit production. Only a few relatively large farms (with more than 200 does) are specialized. Diagnostic surveys show the incidence of technical constraints, effecting directly on production performance and profit. In 1995, INIA (National Agriculture Research Institute) started applied research in meat rabbits, focusing on nutrition, reproductive management and housing. More recently, the participation of INIA in genetic improvement has been prioritized. In 1999, using embryo transfer techniques, two genetic lines (V and R) from Valencia Polytechnic University were introduced. A selection program has been scheduled, including the generation of a third line, on the basis of the genetic resources available in the country. The coordination of joint actions with farmers´ organizations and government extension agencies constitutes a key factor for the effective diffusion of technical information and genetic improvement.

RABBIT PRODUCTION IN URUGUAY

Rabbit production may be considered as a traditional activity in Uruguay, presumably introduced for self-consumption by Spanish and Italian immigrants that constitute the major ethnic origin and principal source of cultural heritage for the Uruguayan population. However, the initial market-oriented rabbit farms were dedicated to hair production, making possible exports between 1950 and 1960 (Olivero, personal communication).

About 1970 started the meat rabbit production development, reaching the peak of maximum activity in the 80´s decade. At that time, PROINCO, a private enterprise, concentrated production and commercialization, with more than 6.000 does. This enterprise had the biggest slaughter house in South America, with official approval for exporting to Europe.
Since 1986, after commercial failure and bankruptcy of PROINCO, began a period of stagnation of rabbit production, characterized by alternative cycles of active growth followed by rapid declination. This situation seems to change since 1995, initiating a stage of progressive growth. Table 2 shows the evolution of rabbit meat production between 1992 and 1999.

A decisive factor in the evolution of rabbit production in Uruguay is the ratio between prices of rabbit and pelleted food. Average food price increased from 0.28 US$ in 1990 to 0.34 US$ in 1996. Since 1996 started a gradual decline of food price (Table 3), partially due to the drop of the international price of cereals, plus a more stable situation of the Uruguayan economy with a substantial contention of endemic inflation.

Table 2. Rabbit meat production (carcass weight kg/year).

YEAR	RABBIT MEAT (Kg/year)
1992	76.800
1993	120.000
1994	120.000
1995	216.000
1996	216.000
1997	230.000
1998	242.000
1999	245.000

Source: Based on statistics from JUNAGRA – MGAP.

Table 3. Average price of pelleted rabbit food.

YEAR	PRICE (U.S. dollars per kg)
1996	0.34
1997	0.30
1998	0.28
1999	0.27

Source: Based on information provided by the Cámara Mercantil de Productos del País.

The ratio between rabbit and food prices, that scarcely reached 4,6 in 1996, raised to values over 6 at the ending of 1999.

MEAT CONSUMPTION IN URUGUAY

Uruguay has only 3.2 million inhabitants, determining a limited domestic market.
Customary patterns of consumption and a relatively low price of beef, determine a very high intake of meat, averaging about 100 kg per inhabitant/year (Table 4). The consumption of lamb is mainly concentrated in rural areas. Historic consumer's preference for beef is a consequence of a favorable combination of quality, price and convenience. In recent years, the share of chicken has been increasing rapidly, as a result of a drastic decline in price; Table 5 shows current retail prices for different meats.

Table 4. Meat consumption in Uruguay (kg per capita/year).

MEAT	1996	1999
Beef	65	61
Lamb	15	11
Pork	6	9,9
Chicken	12	18
Rabbit	0,070	0,075

Source: Based on statistical data from INAC, JUNAGRA and DIEA.

Table 5. Current prices at retail market for different meats (US dollars per kg).

MEAT	PRICE RANGE (U$S)
Beef (loin, rump, ribs)	3.40 – 3.83
Lamb	2.72 – 2.98
Pork (loin, ribs)	4.09 – 4.68
Chicken	1.79 – 2.20
Rabbit	3.91 – 4.42

Rabbit meat occupies a marginal place in the diet of Uruguayan population, being considered a gastronomic speciality or an exotic dish for the majorities. Nevertheless, rabbit meat has gained access to supermarkets and butchers, as a result of improved commercial practices and promotion campaigns. Slaughter live weight usually ranges 2.4 – 2.5 kg. Rabbit is normally presented to the consumer as a whole carcass, without head, containing kidneys and liver, but other forms of presentation, including prepared foods, are progressively tested to motivate consumers response.

RABBIT PRODUCTION SYSTEMS

The rabbit production sector is composed of approximately 250 farmers, prevailing small-scale family units, with an average farm size ranging 20-30 does (Quintans and Elizalde, 1997). The total breeding herd has been estimated in about 8.000 does. The majority of rabbit farms are diversified, combining rabbit production with a variety of other economic activities. Only a few farms with relatively large size (200 or more does) are specialized in rabbit meat production. In general terms, there is a low application of technology, that affects productivity and economic results. The prevailing housing system consists of home-made open-air concrete cages, with floor and front made in electro-solded wire.

A recent survey about kit mortality during lactation (Pérez and Velasquez, 1998) in a representative sample of rabbit farms, allows to identify some distinctive features of the Uruguayan rabbit production. In 31.8% of the farms under study, open-air concrete cages were used for housing does, while 27.3% had wire cages kept in semi-open buildings and 40.9% used a combination of both systems. Approximately 48% of the farms did not utilize artificial lightening to ensure optimal photoperiod and in 23% of cases water was supplied in manually fed concrete troughs. Regarding nutrition of the breeding herd, 72.3% of farms used exclusively a commercial pelleted concentrate, while 27.7% combined pelleted food with fresh forage.

Quintans and Elizalde (1997), on the basis of a diagnostic appraisal, established a typology of farms depending on technology level; according to this, the number of weaned kits per litter was about 20 for the lower level, 30 for the medium level and 42 for the higher level.

Pérez and Velazquez (1998) report an average litter size of 7,93 ± 2,77 total born, 0,69 ± 1,27 stillborn, and 7,25 ± 2,79 born alive. This study revealed an average mortality of 22,6% during lactation, with an average litter size at weaning of 5,61 kits.

Piedra Cueva (2000, personal communication) report an average litter size at weaning of 5,73 and 6,55 for two different rabbit farms of the locality of Minas.

The absence of accurate production records at farm level, determines lack of reliable information concerning performance during the post-weaning growing period. Quintans and Elizalde (1997) state that, depending on technology level, 55 to 75 days after weaning are required to reach slaughter weight. These authors estimate that global food conversion rate (including food consumption of breeding herd), ranges about 4.32, 4.46 and 5.01 for the higher, medium and lower technical level respectively. The effect of technology on economic results is emphasized by these authors, reporting negative values of profitability for those farms with low application of available technical knowledge.

RESEARCH AND TECHNOLOGY

In 1995 was created the Rabbit Experimental Unit in Las Brujas Exp. Station, depending of INIA (National Agriculture Research Institute), responding to the demands of farmers associations. The original objective was the evaluation of production performance and economic results under different housing conditions. With this purpose the Experimental Unit was initially composed of a battery of 60 traditional concrete cages (50 x 100 cm of floor, 50 cm front and 35 cm back) and a shelter containing imported flat-deck wire cages (40 x 90 x 35 cm), 40 for breeding does and 70 for growing rabbits. In a near future, the capacity will be enlarged with:

- an adapted old barn, endowed with forced ventilation, and hydro-cooling system, with flat-deck cages for 120 does, 25 bucks and their corresponding replacements.

- three imported open-air modules, with 100 cages each for growing rabbits
- a small laboratory for artificial insemination
- slaughter room and cold storage chamber

Research activities are supported by a complete animal nutrition laboratory and a modern plant for manufacturing pelleted food, both located in other Experimental Station.

The initial breeding herd was composed of purebred rabbits (New Zealand White, Californian and American Chinchilla) donated by farmers organizations (SUDEC and CALPROCO).

Research objectives have been broadening progressively, according to the priorities established by a Permanent Advisory Working Group.

According to farmers demands (Capra, 1996), the sphere of action for applied research carried out by INIA, should include a broad variety of topics, such as:

- Intensification of reproductive rhythm,
- Prevention and control of respiratory diseases,
- Development of artificial insemination,
- Determination of nutritive value of local food stuffs,
- Adjustment of feeding strategies for different physiologic stages,
- Genetic improvement.

As a result of the interaction among the various agents that integrate the working group (researchers, governmental extension agents, representatives of different farmers´ organizations), emerged a research agenda aimed at generating relevant information and appropriate technologies to solve actual production problems.

One topic emphasized as a focus of attention was the use of different fresh forages (alfalfa, oats, sudan-grass, sweet potato leaves) in combination with pelleted food, as a mechanism of reducing production cost, facing an unfavorable price ratio (below 5:1) between rabbit and pelleted food (Blumetto and Capra, 1997).

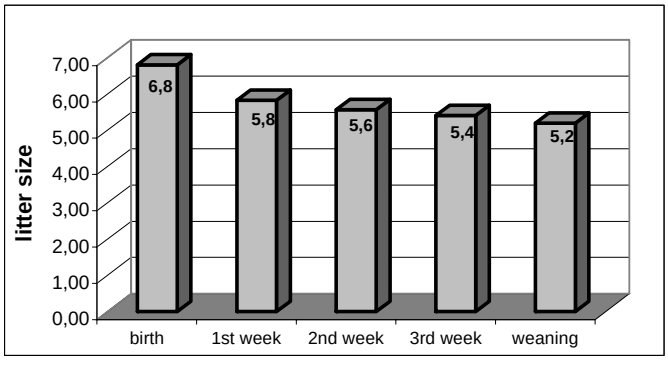
The Rabbit Experimental Unit has become a permanent reference for farmers, determining a consistent strategy toward adaptation and validation of technologies supposed to be adequate to farmers´ circumstances and resources.

Production data records are periodically presented to the farmers as a means of eliciting critical analysis.

In 1996-97, using exclusively pure breeds (New Zealand White, Californian and American Chinchilla), mating 14 days after kindling, with an average lactation length of 30 days, a mean of 36.5 weaned rabbits per female and year was obtained. Effective kindling interval averaged 52 days. In this period litter size averaged 7.9 total born, 6.8 born alive, 1.7 stillborn and 5.2 at weaning.

Figure 2 shows the weekly evolution of litter size along lactation, with a differential distribution of mortality.

Figure 2. Evolution of litter size per week.

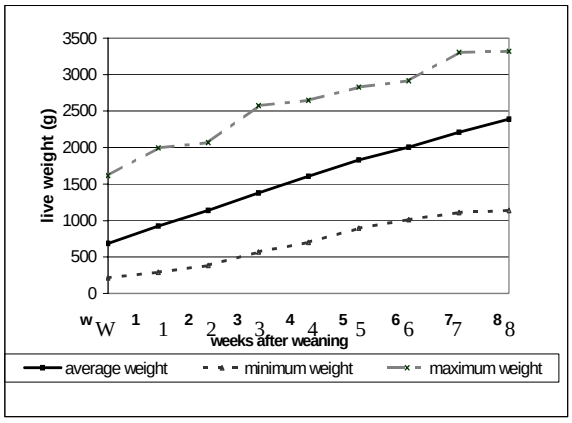


Statistical analysis of reproductive performance records showed no significant differences between breeds and season, but revealed significant differences between housing systems (Blumetto y Capra, 1998). In this particular situation the type of nest constituted a relevant factor affecting litter size at weaning (5.6 *vs* 3.9 kits at weaning, for imported plastic nests and traditional wooden boxes respectively, $P < 0.01$).
At the ending of 1997, two changes were introduced: a six-band management system, mating a group of does every week, and the use of crossbred females (American Chinchilla x New Zealand White and American Chinchilla x Californian) in a proportion of about 30% of the breeding herd. Productivity in 1997-98 raised to 42 weaned rabbits/doe/year.
Regarding the fattening stage, individual liveweight of 956 rabbits weaned in 1998-99 were recorded every week, obtaining the following average values (Table 6). The evolution of liveweight is presented in Figure 3.

Table 6. Average live weight and weight gain (gr.) between weaning and slaughter. 1998.

WEEK WEANING	AVERAGE WEIGHT (g)	AVERAGE DAILY WEIGHT GAIN (g)
weaning	685	
1	925	34.3
2	1140	30.7
3	1379	34.1
4	1607	32.6
5	1828	31.6
6	2008	25.7
7	2212	29.1
8	2392	25.7

Figure 3. Evolution of post weaning liveweight.



In a previous evaluation (Blumetto and Capra, 1996) a group of 150 Californian x New Zealand White crossbred rabbits averaging at weaning 824 g. liveweight, reached a mean slaughter weight of 2457 g. at 74 days of age, with an average daily gain of 37 g/day and a conversion rate of 3.27.

GENETIC IMPROVEMENT

In 1997, the idea of developing a selection program aimed at improving the production potential, became reinforced. Two factors were restricting the availability of high production genetics. Firstly, the existence of sanitary barriers that impeded the introduction of animals or semen unless the origin was a country free from myxomatosis. Secondly, farmers´ strong conviction about the advantages of traditional selection procedures in pure breeds, on the basis of breed standards, neglecting the impact of selection pressure on production characteristics with real economic weight. An agreement for technical cooperation (INIA Spain – INIA Uruguay) made possible the introduction of synthetic lines from Valencia Polytechnic University (UPV), using vitrified embryo transfer techniques to minimize the risk of introducing exotic diseases. (Vicente and Garcia, 1999; García *et al*, 2000).
Taking into account the existing facilities at the Rabbit Experimental Unit, only two lines were imported: maternal line V (green) selected for litter size at weaning and Sire line R (rose) selected for weight gain. A selection program has been scheduled, following the same procedures used in UPV.

At the same time, a joint-venture between INIA and a cooperative, constitutes the framework for the development of a national line (C-sky blue), using a rabbit population derived from PROINCO breeding stock. This population, maintained by a small group of farmers in the surroundings of the locality of Minas, offers promising conditions for the creation of a maternal line (Baselga, 1999), thus allowing a three-way crossing scheme in combination with the lines imported from Spain. This project has received favorable opinions from farmers´ associations (SUDEC and ACUR) and government extension and development agencies (JUNAGRA and PREDEG). Close linkages between INIA and these organizations is a key factor to ensure dissemination of technical information and the diffusion of genetic improvement.

FUTURE PROSPECTS

Uruguay has a series of favorable attributes for developing rabbit meat production:

a) Climate is adequate for rabbit raising, without extremely severe conditions.
b) From the sanitary point of view, the situation may be considered exceptional. The country is free from myxomatosis, rabbit haemorhagic disease and epizootic rabbit enterocolitis.
c) Agriculture is well developed, assuring availability of cereals, forages and other foodstuffs
d) Rural areas have good communications through a network of national highways and local roads; electricity and telephone have also a good coverage in the countryside.
e) The strategic geographic location, at the heart of the regional common market (MERCOSUR), facilitates access to the most important markets of the region (Buenos Aires, San Pablo, Porto Alegre).
f) Uruguayan people have good educational level, making possible training activities and rapid diffusion of technical information.
g) Although few technicians are specifically dedicated to rabbit production, the University has potential capabilities to improve training, matching requirements of the production sector. In fact, rabbit production courses are currently offered as a curricular option in the Faculties of Agronomy and Veterinary.
h) As a matter of fact, Uruguay is the first country in the region that acceded to European rabbit genetic improvement.

However, the effective development of a competitive rabbit meat industry, taking advantage of these favorable conditions, will require improvements in commercial organization and production technology.

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