MAIN LECTURE

Present situation and future challenges of beef cattle production in Italy and the role of the research

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ABSTRACT: The paper aims at describing the current features and the future challenges of the beef cattle production systems in Italy. The first part of the article analyzes the main domestic production systems of veal calves and more adult beef cattle in terms of farm size and location, housing structures, feeding plans and cattle genotypes. The second part is address towards the analysis of a set of issues related to the current systems of production which could become important critical points in the short future. Potential solutions to reduce the environmental impact of the beef farms, to improve the animal welfare and to limit the import of foreign young livestock to be finished in our fattening units are proposed and discussed in the light of the more recent advances of the scientific research.

Key words: Beef cattle, Fattening, Italy, Present, Future.

INTRODUCTION – Italy has a long history and tradition as beef cattle producer and according to the European statistics (OFIVAL, 2007), in the year 2005 the Country represented the third main contributor (11.4%) to the total cattle meat produced within the 25 EU Countries following France (22.5%) and Germany (15.3%). The Italian production of bovine meat considers all the main cattle categories of beef cattle from veal calves to culled dairy and beef cows (Table 1). Data from ISMEA (2006) about the partition of the national production of beef cattle for the year 2005 showed that veal calves represent 13% of the total production and a similar share regards the culled dairy and beef cows. Young bulls and beef heifers are by far the largest share of the domestic production with a 73% of the total. However the domestic supply of veal and red meat does not cover the national demand for both types of meat requiring the import of live cattle and fresh or frozen meat from abroad. The Italian self-supply for cattle meat in the year 2005 obtained dividing the total domestic production by the national consumption was 78%, but this value does not give a realistic picture of the sector and it must be lowered down to 63% since the national production considers also the contribution of animals finished abroad and slaughtered in our abattoirs (CRPA, 2006).

THE ITALIAN BEEF CATTLE PRODUCTION TODAY – Farms size and location

Veal calves – The are no official data describing the mean size of our beef cattle farms. Veal calves fattening units are mainly located in Lombardy and Veneto. According to a recent survey (Cozzi *et al*., 2003a), their average size should allow the housing of 500-600 calves per farm with a wide standard deviation (± 500 calves) due to the presence either of small (100-200 heads) or large units (> 2000 heads).

Young bulls and heifers – The fattening units of more adult cattle can be divided in two aggregates according to their location and production systems (ISMEA, 2006). Absolutely predominant are the intensive farms located in the Po Valley which raise 70-75% of the animals belonging to these categories. The size of these farms changes from region to region. The biggest units with more than 1000 heads are mainly located in Veneto while moving westwards, the mean size of the farm decreases below 400 heads in case of Piedmont. The second type of beef farms are the more extensive ones located in Piedmont and along the Apennines mountains in the Central-Southern part of the Country. These farms raise through the cow-calf system, 25-30% of the total population of young bulls and heifers slaughtered for meat production. Their mean size is very small averaging around 20-25 heads/farm.

Table 1. Main categories of cattle slaughtered for meat production in the year 2005 in Italy (Source: modified from ISTAT, 2007).

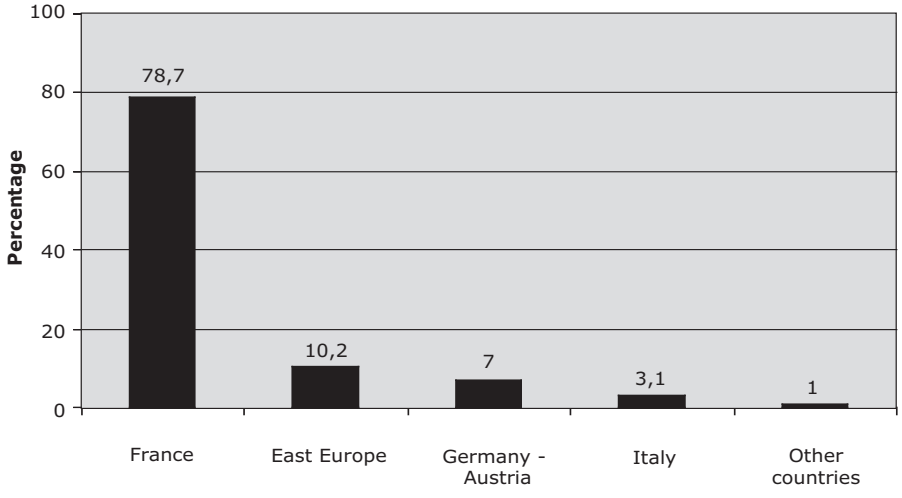
	Heads (000)	Average live weight (kg)	Dressing percentage (%)
Veal calves	988	243	59.2
Beef young bulls	1.949	583	58.2
Beef heifers	565	457	56.3
Culled and beef cows	541	557	46.7

Animals and housing system

Veal calves – The calves reared and slaughtered for meat production in Italy represent 67.6% of the total demand while the remaining (32.4%) is covered by importing veal meat mainly from Holland and France (Cozzi and Ragno, 2003). Italian calves reared for veal production are mainly Italian Holstein or Brown males coming from dairy farms. However, about 23% of the demand of live animals for veal production is covered by calves imported from Poland (14%), France (3%)and Germany (2%) (CRPA, 2006). Veal calves are kept in close barns for the entire fattening period which lasts 5-6 months. According to the 97/2/EC Directive by the European Council, the group housing in multiple pens has been mandatory from December 31st, 2003. There are no data available about the environmental impact of the veal calf units but considering the weak trophic link between this category of beef cattle and the farm land, the average stocking rate might be quite high.

Young bulls and heifers – The dependence on imported cattle of these fattening units is even higher than the veal calf ones. In the year 2005 about 1 million heads finished in our beef farms have been imported from abroad and 80% of them came from France (ISMEA, 2006). The fattening of imported cattle is predominant in Veneto as shown by a recent survey carried out during the first semester of the year 2005 in a sample of 309 beef farms housing 145863 young cattle (Figure 1). French cattle belong to Charolais, Limousin breeds and to different crossbreds while Polish Friesian and Simmental are the main breeds imported from East-Europe. All these fattening units adopt the indoor loose housing of the animals in multiple pens. The predominant type of floor in the pens is the fully slatted because it does not require any bedding material and it has a lower labour cost to remove slurry. Littered pens are adopted for the fattening of bulls slaughtered at heavy live weights. Most of them belong to Charolais since the breed is more sensitive to lameness (Cozzi *et al.*, 2005b). In the intensive beef farms located in Lombardy and Piedmont there is still a prevalence of imported cattle but the percentage of animals born in Italy tends to increase. These farms adopt also the indoor housing of

Figure 1 Country of origin of beef cattle fattened in a group of 309 farms located in the Veneto region. (Source: UNICARVE, 2005).



the cattle in multiple pens but the use of the fully slatted floor is less frequent than the permanent bedding. The extensive farms located in Piedmont and in the Central-Southern regions of the Country mostly raise young bulls belonging to the Italian beef breeds (Piedmontese, Chianina, Marchigiana, Maremmana, Podolica, Romagnola). During the fattening period the animals are housed in pens on permanent bedding or tied in small closed barns.

Besides size, housing solutions and cattle breeds, intensive and extensive farms located in different areas of the Country differ clearly also for the management strategies adopted during the fattening cycle and for their environmental impact as shown in a recent survey carried out by ISMEA (2006). Among the intensive ones, the fattening units located in Veneto have a higher initial weight of the livestock and a shorter duration of the fattening cycle than the beef farms of Piedmont (Table 2). A mutual problem for these farms is the excessive stocking rate when compared with the requirements imposed by the Council Directive 91/676/CEE concerning the protection of water against pollution caused by nitrates from agricultural sources. The extensive producers fully comply with this environmental regulation but they have a much lower productivity due to the prolonged duration of the fattening period needed for raising cattle with a heavier slaughter weight (Table 2).

Table 2. Management of the fattening cycle and stocking rate in a sample of the different type of Italian beef cattle farms (Source: modified from ISMEA, 2006).

Type of farm		Intensive		Extensive
Farm location		Veneto	Piedmont	Toscany
Cattle breed		Charolais and FC[x]	Blonde d'Acquitaine	Chianina
Farm size	heads	1320	380	28
Cattle live weight:				
Initial	kg	368	237	257
Final	kg	641	597	722
Daily gain	kg/d	1.30	1.39	1.25
Cycle duration	d	210	260	372
Stocking rate	LU/ha[y]	7.0	4.5	1.2

[x]FC = French crosses; [y]LU/ha = Livestock Units/hectare.

Figure 2 Average cost per semester of skimmed milk and whey powder in the period January 2003 – March 2007.

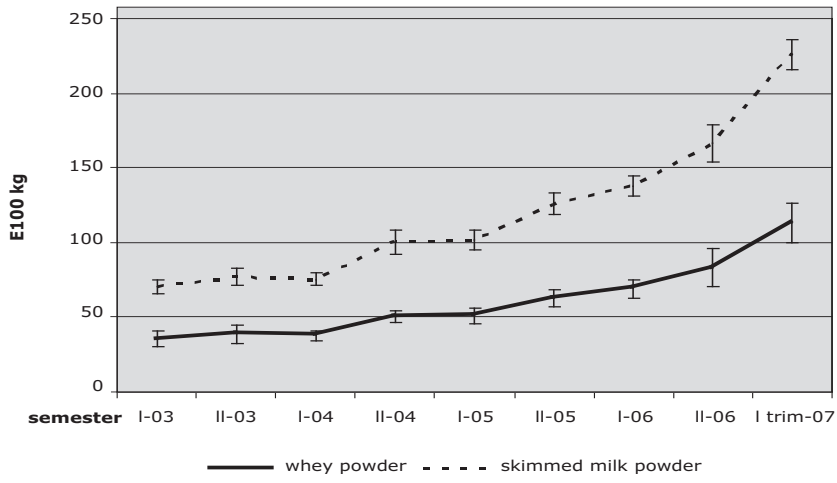


Table 3. Effect of the farm location on feed and chemical composition of total mixed rations for finishing Charolaise bulls (Source: Cozzi, unpublished data).

Farm location	Veneto	Lombardy	Piedmont	SE
Farms (n.)	101	23	11	
Feed categories (kg fresh weight)				
Maize silage	8.3b	9.6a	5.9c	2.2
Maize ear silage	0.8b	1.4b	2.7a	1.5
Cereals meals and grains	2.7a	1.8b	2.1a	1.2
Dried sugar beet pulps	1.1a	0.6b	0.5b	0.7
Long fibre roughages	0.7	0.7	1.0	0.4
Protein-energy-min-vit supplements	2.3	2.6	2.4	1.1
Molasses and vegetal fats	0.1b	0.1b	0.2a	0.2
Chemical composition				
Dry matter (%)	55.2b	52.6b	62.3a	7.0
Ash (% dm)	5.4	5.5	5.4	0.7
Crude protein (% dm)	14.0	13.9	14.0	0.9
Ether extract (% dm)	3.5	3.2	3.1	0.7
NDF (% dm)	31.0b	34.0a	31.9b	3.2
Starch	32.6a	31.1b	31.7b	2.7

Means with different letters (a, b, c) differ for $P < 0.05$.

Table 4. Performance and calculated nitrogen excretion of steers fed diets with different dietary crude protein concentrations during the finishing period. (Source: modified from Cole et al., 2003).

		Dietary crude protein		Δ12/14
		12% DM	14% DM	
Live weight:				
Initial	kg	404	404	
Final (FLW)	kg	496	517	- 4.1%*
Average daily gain	kg/d	1.64	2.02	- 18.8%*
Days of trial	d	56	56	
N intake	g/d	198	240	- 17.6%**
Excreted N	% of N intake	88.7	88.9	- 0.2%
Total N excreted during the trial	g	9820	11938	- 17.7%**
Additional days on feed[1]	d	13	--	
Total N excreted to equalize FLW	g	12004	11938	0.6%

*Difference significant for $P < 0.10$; **Difference significant for $P < 0.05$.

[1]Days required by the steers fed 12% CP diet to reach the same final bodyweight of 14% CP diet steers.

Feeding program

Veal calves – The traditional feeding plan of the veal calves was based on the provision of a milk replacer diet without any addition of solid feeds. However, due to the pressure of the animal protection associations and supported by the opinion of prominent scientific experts on animal welfare (Broom, 1991), from December 31st, 2003 the European Council, through the 97/2/EC Directive, forced the mandatory feeding for welfare purpose of a small amount of roughage in addition to the liquid diet. More recently a further change in the feeding program is occurring because of the continuous increase of the costs of skimmed milk and the whey powder, two of the main row materials used for the milk replacers formulation (Figure 2).

Young bulls and heifers – Under intensive rearing conditions, fattening bulls and beef heifers are fed high concentrate diets to promote their maximum daily gain and a small amount of roughage is provided just to allow a minimum rumination (Campbell *et al.*, 1992). Most of the intensive fattening units located in the Po Valley provide the diet as total mixed ration (TMR) to promote a synchronized intake of roughage and concentrates which decreases the risk of the occurrence of metabolic acidosis. Maize is the main crop used for the formulation of these diets and it is fed either as dried ground meal or as high moisture ear silage and whole plant silage. Even considering the same cattle breed, the feed composition of the diets changes according to the geographical location of the fattening unit. Data of Table 3 collected in a sample of 135 beef farms raising Charolaise young bulls show how, consistent with the dairy producers, beef farmers of Lombardy feed the maximum amounts of maize silage and lower the use of cereals meal. In Veneto there is the largest use of dried beet pulps and maize meal while in Piedmont maize silage is partially replaced by maize ear silage. Among long fiber roughages, straw is almost the only source included in the beef rations of Veneto and Lombardy while in Piedmont this roughage is partially or fully replaced by meadow hay. Feed composition and the physical form of the diet changes significantly in the case of the extensive farms (ISMEA, 2006). The use of maize silage is marginal and this forage is fully replaced by legume and meadow hays (Sargentini *et al.*, 2005). The provision of ensiled forages is even forbidden during the last four months of the fattening period by the disciplinary of Protected Geographical Indication European mark of the "Vitellone Bianco dell'Appennino Centrale" (Reg. EU n. 134/98). Most of the dietary energy comes from starch sources like maize and barley meal while there is no use of sugar beet pulps and the protein is mainly provided by luzerne hay, field bean and soybean meal. The diet is seldom provided as total mixed ration and the concentrates are usually top-dressed to the forage portion once a day.

THE FUTURE CHALLENGES AND THE ROLE OF THE RESEARCH – Several factors which actually feature the Italian beef cattle husbandry could become important critical points in the short future.

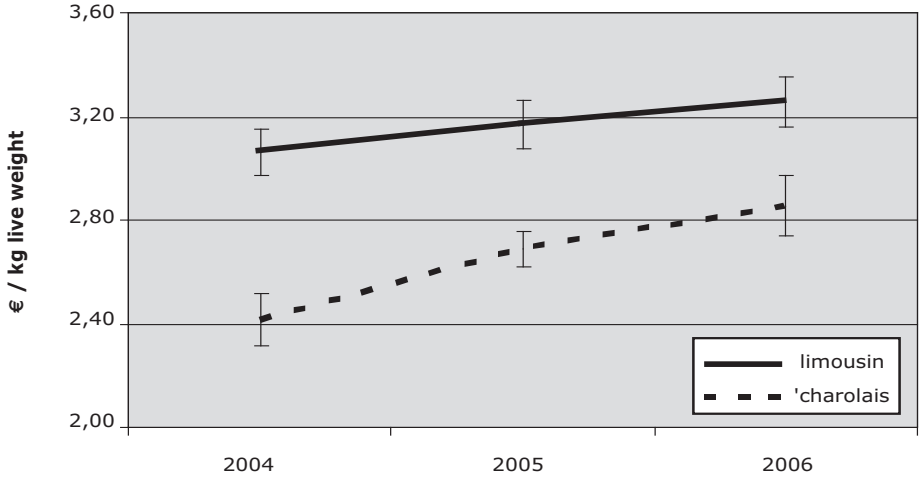
The environmental impact

This absolutely represents the main priority which has to be faced by the veal fattening units and the intensive beef cattle farms located in the Po Valley in order to comply with the requirements imposed by the Nitrate Directive 91/676/EC. Besides the simplest solution of downsizing the stocking rate of the farm, one of the suggested strategies to reduce the nitrogen excretion is the decrease of nitrogen input by lowering the crude protein concentration of the diet. However, data of Table 4 derived from Cole *et al.*, (2003) show that, if cattle performance is adversely affected, the reduced daily output of nitrogen could actually be counterbalanced by the additional days on feed required to reach the optimal slaughter weight. Efforts should be made by the scientific community in order to increase the efficiency of retention of the dietary nitrogen which is actually 10-20% in beef cattle (Flachowsky et al, 2006; Xiccato *et al.*, 2005) and 50% in veal calves (Xiccato *et al.*, 2005). To fully meet the protein requirements of the pre-ruminant calves it appears important to better measure the true digestibility and the efficiency of absorption of the essential amino acids of the different protein sources included in the milk replacers and particularly of those of vegetable origin. In the case of more adult beef cattle, nutritionists should address specific studies towards the identification of suitable feeding strategies to maximize microbial growth in the rumen which is consider an other key factor to decrease nitrogen excretion. Research on dairy cows has shown a decrease in efficiency of microbial protein passing to the small intestine when concentrates exceed 70% of the total dietary dry matter (Clark *et al.*, 1992). A recent study carried out on a large set of more than 400 Italian beef cattle diets showed concentrate being on average 62.1 ± 10.5% of the total ration DM. However, 21.6% of the samples were above the suggested threshold (Mazzenga and Cozzi, 2007).

The dependence on imported cattle

One of the weak points of the national beef production is the large import of young livestock to be raised and finished in our fattening units. This dependence year after year becomes a greater limiting factor for the management and the economic success of our farms not only because of the increasing trend of the cost of foreign cattle (Figure 3) but also for the constraints and the additional costs imposed by the European regulation n. 1/2005 on the protection of animals during transport. Several strategies could contribute to reduce this dependence and first of all, the incentive to devel-

Figure 3 Average price of Limousin (live weight 300 kg) and Charolais (live weight 400 kg) young bulls in the years 2004 – 2006.



op beef cow-calf farms in marginal areas of the Country particularly where there are no convenient agronomic alternatives to the livestock grazing on pasture. In the field of the reproduction, a significant improvement of the value of the calves for meat production could come from the crossbreeding of the dairy and dual purpose cows with bulls of beef breeds. In a dairy herd a simple two-way cross by mating the cows not used to produce the replacements with beef breeds bulls is a common practice to increase the commercial value of the offsprings sold to the veal and beef producers. However, the real contribution of this strategy becomes marginal if the reproductive efficiency of the herd is particularly low like in the case of many Italian Friesian farms where the cows culling rate is above 35% (AIA, 2005). Further support to the improvement of the fleshiness traits of our young cattle population used for beef production could come from a routinely application of specific biotechnologies in the field of reproduction as in the case of the production and use of male sexed semen of beef bull in crossbreeding schemes (Bittante *et al.*, 2006).

The new feeding strategies

The environmental impact issue, along with the increasing cost of specific feed ingredients currently supplied to veal calves and young bulls are expected to make a significant change in their future diets. The sharp increase observed in the last year for the price of skimmed milk and whey powders (Figure 2) is not supposed to flat in the short run due to their rising demand by the Asian Countries, China in particular. In this scenario, the scientific research is trying to find new solutions to fulfil the growth requirements of veal calves. Particularly promising is the attempt to reduce the amount of milk replacers by feeding the calves large amounts of solids feeds (Suárez *et al.*, 2006a) since it has the potential to lower the cost of feeding and it stimulates the rumen development (Suárez *et al.*, 2006b) which is considered an important welfare issue for these animals. Key factor for the success of this strategy will be the selection and combination of solid feeds with a low iron bioavailability in order to avoid detrimental effects on veal meat colour (Cozzi *et al.*, 2002).
In the case of young bulls and heifers, the attempt to reduce the nitrogen excretion and the physiological and ethological need for long fibre roughage should probably address the future ration formulation of our intensive farms towards a general increase of the forage:concentrate ratio. In many feeding situations, the application of this new concept of feeding beef cattle should lower the current starch concentration of the diet. However, an interesting solution to be applied in order to avoid an excessive drop in the dietary starch content might be the inclusion of large amounts of coarsely chopped maize silage. This feeding strategy has been evaluated by our research group in a recent study which compared a TMR made with this type of forage as the sole roughage source to a Control diet formulated with straw and a conventional maize silage (Cozzi *et al.*, 2005a). Diets were isofibrous, but the ration with the coarse silage had a higher forage:concentrate ratio (45:55 on DM basis) than the Control one (32:68). As summarized in Table 5, growth and slaughter performance of the Limousin bulls used in the study were not affected by the different roughage source of the diet, while an interesting result from an animal welfare point of view was the prolonged rumination per unit of DM and NDF intake performed by the animals fed the coarse silage diet.

Table 5. Growth performance, feeding behaviour and dressing percentage of finishing Limousine bulls fed diets based on different source of roughage (Source: modified from Cozzi *et al.*, 2005).

		Dietary source of roughage		SE
		Control maize silage + Straw	Coarse maize silage	
Live weight:				
Initial	kg	426	426	7
Final (FBW)	kg	622	613	39
Average daily gain	kg/d	1.43	1.35	0.25
Feed intake:				
Dry matter	kg/d	9.02a	8.30b	0.35
NDF	kg/d	2.92a	2.64b	0.11
Ruminating time		9820	11938	
/ kg DM	min	35b	40a	3.0
/ kg NDF	min	107b	125a	9.9
Dressing out	%	62.6	62.0	16.3

Means with different letters (a, b) differ for $P < 0.05$.

The animal welfare issue

It has been previously mentioned how the traditional rearing system of the veal calves has been recently revolutionized by the 97/2/EC Directive for the protection of calves imposing the adoption of the group housing and the provision of a small amount of roughage in addition to the liquid diet. Europe has no regulation on animal welfare in force regarding young bulls and heifers, likely due to the large differences existing among the fattening systems operating in the member Countries. However, many Italian intensive farms were below the threshold of acceptance for several resource based parameters suggested by the EU report on the welfare of cattle kept for beef production (SCAHAW, 2001). According to a survey carried out by Gottardo *et al.*, (2003), space allowance, type of floor of the pen and manger space were the main causes of unsuitability. Particularly worrying for our producers are the recommendations made by the scientific community against the use of pens with a fully slatted floor. This type of housing, compared with the deep litter, has shown to impair bulls' behaviour by increasing abnormal positions both in standing and in lying (Wierenga, 1987) and the frequency of leg and foot injuries (Murphy *et al.*, 1987).

From the animal welfare point of view, another weak factor for our beef farms is the almost complete absence of moving and loading facilities for cattle. This fact has been underlined by Nanni Costa *et al.*, (2001) after a large survey on the pre-slaughter cattle condition in Northern Italy and it has negative implications both on animal welfare and meat quality. Moving cattle towards the lorry rump without dedicated alleys makes animal nervous and less cooperative, increasing the worker's risk of being injured. The use of electric prods to speed up the loading operations does not help and it should be avoided since it impairs cattle welfare and it enhances the risk of a severe carcass depreciation due to bruising or to the occurrence of dark cutting beef (SCHAW, 2002).

CONCLUSIONS – Italy has still a prominent position in the European scenario of the beef cattle production but the maintenance of a significant domestic production requires the identification and adoption of effective solutions capable to face and solve some impellent issues, the environmental impact in particular. In order to be accepted by the official institutions, all these solutions must be based on robust scientific knowledge and therefore beef producers should recognize the scientific community as an essential partner to work with. Like in other European Countries, specific research projects, useful to defend or to promote our beef production systems, should be proposed and partially supported by beef farmers and their representing organizations.

An other key factor for the future of the national veal and beef production is the capacity to capture the consumer trust in the Italian meat, through the achievement of top quality and safety standards. This implies a strong effort by the entire productive chain towards the adoption of clear, "clean" and transparent feeding and management strategies to allow the complete traceability along the chain itself. The future development of "welfare friendly" productive chains is another challenge which could promote the purchase of national meat.

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