QUANTITY AND QUALITY ASPECTS OF GOAT PRODUCTION IN ITALY

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Abstract

In spite of some positive aspects, such as climate adaptability, high productivity and optimal nutritional level, the Italian goat breeding has not sufficiently developed.
Breeding technics and feeding are responsible for this productive and economic slowness.
The use of bad feeding technics, both in extensive and in intensive breeding, means a low production level, a worsening of milk features, flock fertility and meat quantity and quality.

Résumé

En dépit des éléments positifs qui le caractérisent, tels que l'adaptation aux différents climats, la haute productivité et la bonne valeur nutritionnelle des productions, l'élevage des chèvres ne s'est pas développé en Italie.
Ceci est dû aux techniques d'élevage et au type d'alimentation, qui en pénalisent les résultats productifs et économiques.
L'utilisation de techniques alimentaires inadéquates, aussi bien des élevages extensifs qu'intensifs, comporte un faible niveau de production, un empirement des caractéristiques du lait, de la fertilité du troupeau et de la quantité et de la qualité des viandes.

Goat raising ([1]) is a marginal sector of the Italian breeding activity, as its productions — milk and meat — only stand for 1.1% and 0.27% of the total gross domestic marketable production. Nevertheless, goats always have scientific and technical interest (45) (70) (15) for: a) their adaptability to unfavourable soils and climates (hard breeds) and to intensive breeding conditions (milch breeds); b) higher productions — at the same stocking rate — than those obtained with other species, conditions being equal; c) the high nutritive and dietetic value of their milk; d) the high quality of their meat, in young subjects; e) the lack of political and economic constraints (milk shares) to their diffusion — at least till now. Among the main technical factors strongly influencing their spread — namely in Southern Italy and in extensive areas — (production unsuitable exploitation, low productivity of work, lack of adequate defence, low production), feeding is one of the most important. That is why, after examining the main technical features of the Italian goat breeding, we will study feeding and its relations with milk and meat quantity and quality.

The Italian goat breeding feature

Only a small part of the Italian goat breeding accounts for well defined ethnic groups, which may be assimilated to breeds. On the contrary, it is primarily represented by heterogeneous populations, as for origin and morphological, productive and reproductive features, taking their name from the origin area or the breeding region.
The Italian goat stock (1,246,000 heads on the 31st of December 1989), which is 1% of the total zootechnic one (**table 1**), in mature conventional heads — MCH — has not changed during the last years (**figure 1**). Its distribution is equal to 50% on 16% of the national territory: Sardinia 23.2%, Calabria 16.5%, Basilicata 10%. Its incidence on the regional livestock, in MCH, is low, even in the regions where it is higher: 6.2% in Basilicata, 5.5% in Calabria and 3.5% in Sardinia.
Milk production — 988,150 q in 1988 (**table 2**), with a medium fat content (calculated on the 37,000 q processed by cheese industries) (39) of 4.43% — has not greatly changed (**figure 2**) during 84-88. It is concentrated, in the regions where the species is largely spread, proportionally with the stock consistency, except for Piemonte which produces 8.2% of milk with 5% of heads. It is however marginal, even in quantity terms, related to both the total production of the four milch species (with 13% in Basilicata) and that of cheese industries for industrial processing (0.048% of total milk, as 4% fat corrected milk).
Meat production, represented by young animals for 70%, amounted to 37,348 q (**table 3**) in 1988; it was maximum in Calabria (14.7% of kids and 21.7% of goats) and minimum in the three North-Eastern regions

Table 1 ***Consistence of the Italian goat stock (in thousand of heads) in 1989*** **(ISTAT, 1990).**

Region	Does	Goats	Distribution regional (in %)	MCH	Goats/MCH (in %)
Piemonte	42	62	4.98	1.449	0.43
Valle d'Aosta	2	3	0.24	38	0.79
Lombardia	32	42	3.37	2.698	0.16
Trentino-Alto Adige	8	12	0.96	238	0.50
Veneto	8	15	1.20	1.388	0.11
Friuli-Venezia Giulia	6	8	0.64	225	0.36
Liguria	6	8	0.64	37	2.17
Emilia-Romagna	10	23	1.85	1.582	0.15
Toscana	23	44	3.53	390	1.13
Umbria	6	9	0.72	251	0.36
Marche	6	11	0.88	260	0.42
Lazio	39	59	4.74	540	1.09
Abruzzo	16	25	2.01	237	1.06
Molise	14	18	1.44	102	1.76
Campania	57	94	7.54	523	1.80
Puglia	58	83	6.66	307	2.71
Basilicata	71	125	10.03	203	6.17
Calabria	130	205	16.45	371	5.53
Sicilia	68	111	8.91	694	1.60
Sardegna	204	289	23.19	845	3.42
ITALY	806	1.246	32.10	12.378	1.01

1 MCH=1 Cattle=1 Horse=5 Pigs=10 Sheep=10 Goats.

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([1]) Some researchers have recently studied its general aspects (44) (63) (17) (52), breeding technics (16) (30) (18) (36) (42) and management systems.

(4% of kids and 1.7% of goats) except Valle D'Aosta, and in the two Central-Eastern regions (1.1% of kids and 0.7% of goats). The officially recognized Italian goat breeds (Camosciata delle Alpi, Garganica, Girgentana, Jonica, Maltese, Saanen, Sarda) amount to (**table 4**) 532,000 heads, that is 44% of the total goat stock (5): it corresponds to the total goat stock raised in Sardinia for Sarda (50% of the Italian breeds); it amounts to 100,000 for Garganica and to 50,000 (that is 10% of the total) for the 5 remaining breeds.
In spite of their spread during the last 5 years, functional controls for milk production concern a small amount of the single ethnic groups, with a maximum value for Camosciata delle Alpi (7.3%) and a minimum value for Sarda (0.55%); in 1990, this production was (**table 5**) maximum for Saanen (l 549±172) and minimum for Sarda (l 179±65) and it underwent an increase for all breeds and for almost all categories, in relation to 1985 data. It is greatly seasonal in all breeds; kiddings are, in fact, mainly concentrated (**table 6**) during autumn and winter (82% in Maltese, 92% in Saanen, 89% in Camosciata, 98% in Sarda), because of the ovary activity recurrence, typical of the species.
The current breeding system is: extensive or half-extensive, both in Northern and in Southern Italy, in hilly and mountain areas, which cannot be used for other purposes, in medium and big self-managed farms (Sarda, Appenninica, Garganica); intensive or half-intensive in Southern Italy, in small family farms (Girgentana, Jonica and Maltese) and in Central-Northern Italy, in big capitalist farms, usually associations or cooperatives (Camosciata and Saanen). Herd size, which was evaluated on 1990 functional controls, was (**table 7**), small in Maltese (73% of breedings and 31% of heads in <50 goats classes) and in Girgentana (100% of breedings and heads in <30 goats classes); medium, with a uniform distribution, in Saanen and Camosciata; medium to big in Sarda (71% of breedings and 89% of heads, in >30 goats classes) and in Jonica (70% of breedings and 93% of heads in 30-200 goats classes).

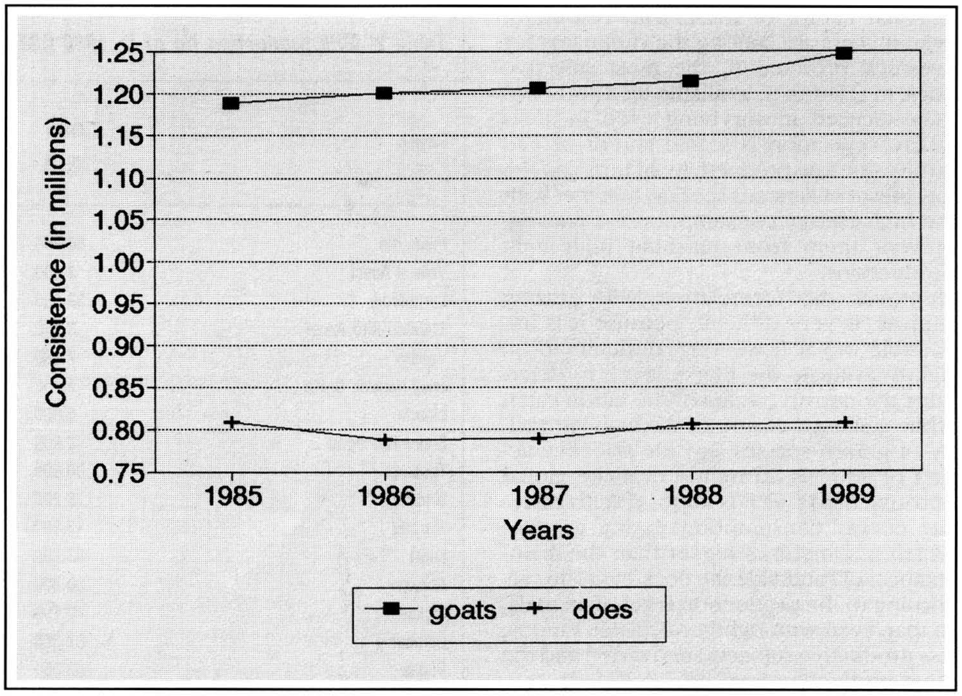

Figure 1 - Evolution of Italian goat population.

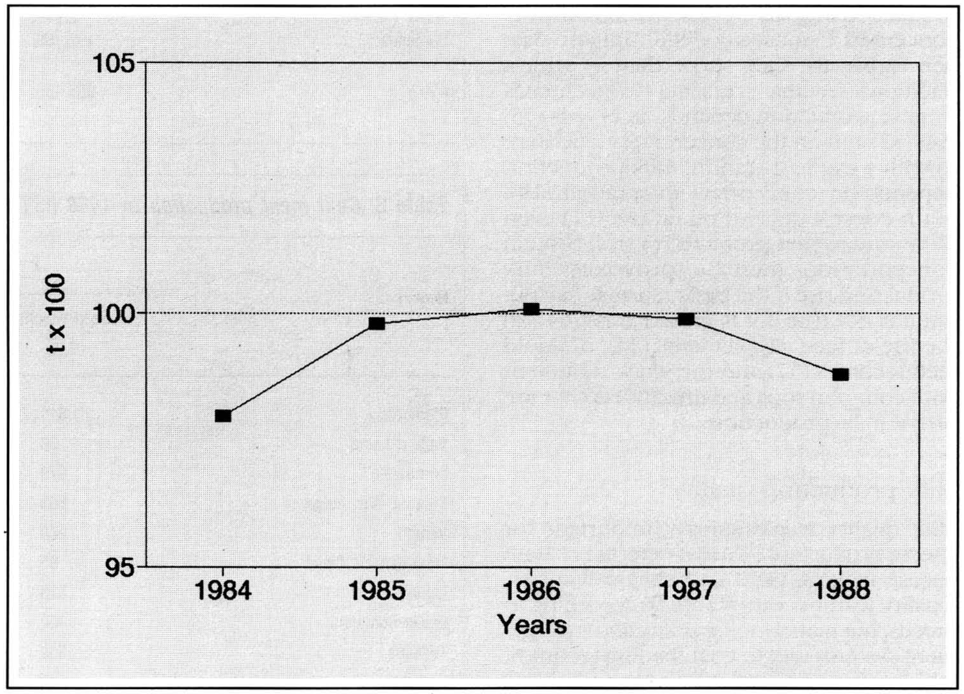

Figure 2 - Evolution of goat milk production in Italy.

Animal feeding and milk production

As everybody knows, feeding is, for goats too, one of the most important technical factors improving production potentialities (6): using bad feeding technics means in fact a low production level in extensive breeding and almost always a worsening of milk quality features in the intensive one.

Milk production quantity

Goat feeding in intensive breedings (71) is based on preserved feedstuffs (hays, silage feeds and concentrates) given in mangers: hence, the production response of animals depends on ration formulation and distribution and on feed quality; thus rationing is the right determination of animal nutritive needs and intake level and the detection of concentrate quantity (proteic, fibrous, mineral and vitamin concentration) to integrate the basic ration. Animal response in terms of production to higher concentrate doses is high, mainly during lactation first stage (64) (19): in this period the low energetic concentration may provoke chetonaemia occurrence, because of an exagerated mobilization of bodily fats, with production decrease, intake level reduction, abomasum dislocation and general immune depression, sometimes causing death. According to some studies carried out on Sarda go ats, at the beginning of lactation, feed with hay, compared to hay and concentrates, the lactation curve trend doesn't seem to be influenced by the feed ration energy level (19).
Goat feeding in extensive breeding is mainly based (18) (62) (20) on grass and shrub or tree grazing, during the whole year: milk production is strongly influenced by the

seasonal nature of these wild resources; even if goats are, among the ruminants for livestock production, the most selective ones, in relation to available feedstuffs and they succeed in surviving even in areas where vegetation is scarce and/or of bad quality, the low productivity of turfs and the low intake of ligneous species, together with the high energy consumption for grazing, prevent them from reaching high milk productions.
Moreover, diet formulation, with grazing animals, is very difficult, because it is impossible or, at least, very difficult, to: a) rightly evaluate the intake level; b) determine the nutritive value of the ration eaten while grazing, because of the high variability of grazed species and the selective action of animals; c) rightly evaluate global nutritive needs, as it is impossible to calculate energy consumption during grazing, which is sometimes higher than the maintenance; d) subdivide the flock in groups according to the production level of animals, so that, even with rightly calculated rations, less productive subjects are overfed and the most productive ones are underfed.
Researches carried out in Italy on the relation existing between feeding and milk production in goats are few and have mainly concerned Camosciata delle Alpi and Saanen (**table 8**); they show that: a) with a traditional feeding — grazing + concentrates — milk production depends on breeds (53) (54) (32) and on the concentrates kind (64); b) with a hay basic ration, milk production depends on concentrate integration (19), but it doesn't depend on fat use (11) even if they are rumen-protected (33); c) protein concentration increase provokes milk production rise if the basic ration is hay (4), but it is not true if it is grazed grass (64); d) the use of feed supplements (24), of liquid feed technics (57) and the straw treatment with common soda and urea (60) do not improve milk production.

Milk production quality

Milk quality is particularly important for cheese production (46) as it determines both cheese making yield and cheese features. Quality features vary (**table 9**) according to breeds, but namely to breeding and management systems and to goat feeding technics, which differ from one region to another (16) (21) (22) (23) (36) (50) (41).
Goat milk unfortunately has low cheese making yields — namely in highly productive breeds (Saanen and Camosciata), but also in the best subjects of other breeds — because of the low dry matter and casein content (49); however, it can be rapidly improved at the farm level, by adequate feed technics (58).

Milk fat content

Milk fat content is positively correlated to the rumen production of acetate and butyrate, which are the main precursors of lipids synthetized by udder: a low

Table 2 ***Milk production (in q) in 1988*** **(ISTAT, 1990).**

Region	From goats	Regional distribution (in %)	Total	Incidence on total production (in %)
Piemonte	80.950	8.19	8.787.400	0,921
Valle d'Aosta	3.500	0.35	421.500	0.831
Lombardia	39.350	3.98	31.834.500	0.124
Trentino-Alto Adige	3.400	0.34	3.780.900	0.090
Veneto	7.100	0.72	11.638.200	0.061
Friuli-Venezia Giulia	2.100	0.21	2.560.300	0.082
Liguria	6.400	0.65	528.400	1.211
Emilia-Romagna	3.900	0.39	18.154.850	0.021
Toscana	30.800	3.12	1.828.100	1.685
Umbria	6.200	0.63	691.400	0.897
Marche	12.300	1.24	870.100	1.414
Lazio	53.200	5.38	6.002.900	0.886
Abruzzo	30.800	3.12	1.478.000	2.084
Molise	19.700	1.99	771.900	2.552
Campania	87.300	8.83	4.252.700	2.053
Puglia	66.050	6.68	2.831.700	2.333
Basilicata	94.050	9.52	700.900	13.418
Calabria	122.400	12.39	2.158.600	5.670
Sicilia	126.500	12.80	3.228.900	3.918
Sardegna	192.150	19.45	3.764.800	5.104
ITALY	988.150	100.00	106.285.800	0.930

Table 3 ***Goat meat production in 1988*** **(ISTAT, 1990).**

Region	Kids		Does and buks	
	Dead weight (in q)	Regional distribution (in %)	Dead weight (in q)	Regional distribution (in %)
Piemonte	1.610	6.33	320	2.69
Valle d'Aosta	38	0.15	20	0.17
Lombardia	870	3.42	320	2.69
Trentino-Alto Adige	650	2.56	160	1.34
Veneto	280	1.10	30	0.25
Friuli-Venezia Giulia	85	0.33	15	0.13
Liguria	325	1.28	315	2.64
Emilia-Romagna	150	0.59	110	0.92
Toscana	550	2.16	460	3.86
Umbria	240	0.94	60	0.50
Marche	40	0.16	25	0.21
Lazio	750	2.95	840	7.05
Abruzzo	2.400	9.43	960	8.06
Molise	1.040	4.09	120	1.01
Campania	2.180	8.57	620	5.21
Puglia	3.680	14.47	1.380	11.59
Basilicata	2.985	11.73	900	7.56
Calabria	3.750	14.74	2.590	21.75
Sicilia	1.125	4.42	345	2.90
Sardegna	2.690	10.57	2.320	19.48
Italy	25.438	100.00	11.910	100.00

Table 4 ***Consistence of main Italian goat breeds.***

Breed	Consistence 1986			Milk recording 1985		Milk recording 1990	
	Heads	% of breed	% of total	Heads	% of breed	Heads	% of breed
Camosciata	40.000	7.52	3.33	2.662	6.66	2.932	7.33
Garganica	107.000	20.11	8.91				
Girgentana	9.000	1.69	0.75	93	1.03	121	1.34
Jonica	19.000	3.57	1.58	477	2.51	926	4.87
Maltese	48.000	9.02	4.00	618	1.29	1.912	3.98
Saanen	42.000	7.89	3.50	2.770	6.60	2.595	6.18
Sarda	267.000	50.19	22.23	595	0.22	1.476	0.55
Total of breeds	532.000	100.00	44.30				
Other populations	669.000	—	55.70				
Total	1.201.000	—	100.00				

Total of individual breeds: estimate ASSO.NA.PA 1987.
Milk recording: data A.I.A.; 1985, 1990.

Table 5 ***Milk production (in litres) of Italian goat breeds (A.I.A.).***

Breed	1985			1990			Variation 90/85 (in %)
	n.	mean	SD	n.	mean	SD	
(1 th-kiding)							
Maltese	96	293	91	158	266	95	− 9.22
Girgentana	14	326	86	11	371	104	13.80
Saanen	466	307	98	666	342	88	11.40
Camosciata	436	270	80	677	314	90	16.30
Sarda	24	99	24	86	111	19	12.12
Jonica	61	272	49	138	240	68	− 11.76
(2nd-kiding)							
Maltese	118	420	168	578	284	159	− 32.38
Girgentana	26	469	133	19	468	173	− 0.21
Saanen	635	487	170	642	549	170	12.73
Camosciata	622	381	130	753	465	146	22.05
Sarda	87	158	47	203	156	47	− 1.27
Jonica	148	326	69	279	388	92	19.02
(mature)							
Maltese	364	336	174	941	349	147	3.87
Girgentana	41	445	115	66	539	186	21.12
Saanen	982	509	192	1.183	549	172	7.86
Camosciata	1.083	459	161	1.257	518	174	12.85
Sarda	260	160	45	829	179	65	11.88
Jonica	266	386	71	548	396	119	2.59

(acetate + butyrate)/propionate ratio stimulates insulin secretion, which inhibits the release of fatty acids belonging to the adipose tissue. This provokes the reduction of plasmatic lipids usually available for udder. Milk fat content may be however modified by feed, namely varying the ration fibrous concentration, by fats and feed additives. The ration fibrous concentration NDF (cell walls contents) is positively correlated with milk fat content (60), even if, in common breeding, it is difficult to interpret this phenomenon: in fact, the higher NDF concentration provokes the lower ration digestibility, thus its energy value and the feed intake are lower. Consequenlty, as the two characters are negatively correlated, milk production decreases, while fat content increases (+ 0.24% per kg of milk less (69)); moreover, the kind of fibre (hay vs hydrolized straw) contained in the complete rations, administered to lactating goats, should not influence this parameter (56). The fibrous content value alone is not a good technical reference forration formulation: in using different feeds, one should consider the other features, both chemical (cell wall kind and reserve carbohydrates) influencing rumen degradation kinetics, and physical (cereal grinding size and fodder chopping) which are strictly correlated with chewing and rumen transit times. The real nutritive value of feed rations depends in fact on these features. The ration fibrous content could be better evaluated by one of the forage intake indexes (particle average length x NDF or ADF or ADL forage intake), which positively influences (**table 10**) milk fat content, the ration ADF concentration and the goat milk production being equal.
The ration fat added influences both quantity and quality of milk fat. The use of

rumen-protected fats (preventing digestibility reduction, which instead occurs when using ration with a lipidic concentration higher than 5%) in lactating goat feeding makes (**table 11**) milk fat content increase, changing its acidic spectrum (**table 12**). The use of feed additives (buffers, rumen-protected amino-acids, epatic metabolism regualtors, auxins, etc.) also changes milk fat content: buffer, such as sodium bicarbonate, keep rumen pH at levels which are good for cellulolythic fermentations, determining a higher acetate production (25) and, consequently, a higher fat content; rumen-protected methionine, 1 g/head per day, should favour fat production (24) thanks to its liver sustaining action; auxins, on the contrary (monensin, avoparycin, flavomycin, etc.) decrease milk fat content, as they provoke a higher propionate production by rumen, to the detriment of acetate production (60).

Milk protein content

Milk protein content cannot be influenced by feeding as easily as lipidic one, because body proteins are not so mobile as fats, to face deficits and/or nutrition disorders. Ration protein concentration increase usually means milk production increase, without modifying its protein content (4); only in case of protein surplus, both absolute and

Table 6 ***Kidding season distribution (in %) of the Italian goat breeds (A.I.A.).***

Year	1985				
	Kiding	Season			
Breed		W	S	M	A
Maltese	618	41.09	15.20	8.41	35.28
Girgentana	93	47.32	2.16	27.96	22.58
Saanen	2.814	89.66	8.67	0.15	1.53
Camosciata	2.684	83.97	14.12	0.19	1.71
Sarda	596	63.76	1.85	0.00	34.39
Jonica	506	31.82	7.31	3.16	57.70
Year	**1990**				
	Kiding	Season			
Breed		W	S	M	A
Maltese	1.968	41.11	11.34	6.96	40.60
Girgentana	124	28.23	12.10	24.19	35.48
Saanen	2.701	86.11	7.26	0.52	6.10
Camosciata	2.953	85.20	10.94	0.27	3.59
Sarda	1.523	49.19	1.57	0.00	49.25
Jonica	1.001	41.46	12.78	2.50	43.25

W=winter; S=spring; M=summer; A=autumn.

Table 7 ***Flock size and goat distribution by breed (A.I.A.).***

1985																		
Breeed			1-10		11-20		21-30		31-50		51-100		101-200		201-300		>300	
	F	G	F	G	F	G	F	G	F	G	F	G	F	G	F	G	F	G
Maltese	23	618	34.8	9.4	34.8	18.1	13.0	14.1	8.7	14.6	4.3	11.3			4.3	32.5		
Girgentana	6	93	33.3	14.0	50.0	60.2	16.7	25.8										
Saanen	52	2.755	15.4	1.9	23.1	6.5	13.5	6.5	21.2	16.0	15.4	20.7	5.8	43.1	3.8	18.5	1.9	16.8
Camosciata	52	2.662	15.4	1.7	21.2	5.8	15.4	7.8	19.2	15.9	13.5	15.4	11.5	30.9	1.9	11.2	1.9	11.5
Sarda	8	595			12.5	2.9	12.5	4.4	12.5	7.2	50.0	51.6			12.5	33.9		
Jonica	9	477	11.1	2.1	11.1	3.1			33.3	23.9	44.4	70.9						
1990																		
Breeed			1-10		11-20		21-30		31-50		51-100		101-200		201-300		>300	
	F	G	F	G	F	G	F	G	F	G	F	G	F	G	F	G	F	G
Maltese	33	1.912	9.1	0.7	21.2	6.1	21.2	9.7	21.2	14.9	21.2	27.5	3.0	7.4			3.0	33.6
Girgentana	8	121	25.0	9.1	50.0	50.4	25.0	40.5										
Saanen	55	2.595	32.7	3.4	16.4	5.3	5.5	2.9	16.4	14.3	14.5	22.5	9.1	21.7	5.5	30.1		
Camosciata	75	2.932	32.0	4.8	20.0	7.8	16.0	10.7	9.3	8.8	10.7	17.1	9.3	30.7	1.3	8.3	1.3	11.6
Sarda	21	1.476	4.8	0.6			23.8	9.7	28.6	15.0	23.8	23.2	14.3	36.1	4.8	15.4		
Jonica	20	925	15.0	1.0	10.0	3.4	5.0	2.7	30.0	24.5	35.0	56.3	5.0	12.1				

E=Flock; G=goats.

Table 8 ***Relationship between feeding and milk production in the goat.***

Breed	Feeling	Milk g/d	Fat %	Protein %	Lactose %	Intake DM kg/d	Authours
Garganica	grazing+concentrates	1.183 (C)	3.87 (A)	3.44 (A)			Pilla et al., 1980
Maltese		1.600 (B)	4.06 (A)	2.85 (B)			
Saanen		2.130 (A)	2.86 (B)	2.15 (C)			
Garganica	grazing+concentrates	1.713	3.70 (a)	3.33 (a)			Pilla et al., 1982
Maltese		1.757	3.67 (a)	3.10 (ab)			
Saanen		2.130	2.87 (b)	2.87 (b)			
Cross breed	grazing+hay+concentrates	674	5.72	3.83	4.31		De Maria Ghionna et. al., 1984
Maltesi	grazing	725	4.28	3.28	4.43		Rubino et al., 1986
	grazing+beans	741	4.38	3.36	4.43		
	grazing+oats+beans	860	4.18	3.19	4.54		
Alpine	alfalfa hay+fatty concentrates	1.600	4.92 (A)	3.55		2.344	De Maria Ghionna et al., 1987
	alfalfa hay+non fatty concentrates	1.620	3.50 (B)	3.40		2.397	
Saanen	alfalfa hay+concentrates	2.240	3.08	3.36		2.801	Bartocci et al., 1988
	alfalfa hay+concentrates +cotton seeds	2.220	3.52	3.35		2.802	
Camosciata	hay+concentrates	2.224	2.85	3.28	4.54		Castagnetti et al., 1988
	hay+concentrates+hydrolyzed	2.502	2.93	3.46	4.43		
	hay+concentrates+methionine	2.650	2.61	2.32	4.43		
Camosciata	complete ration (13% CP)	1.560	3.20	2.62		1.011	Andrighetto et al., 1989
	complete ration (18% CP)	1.790	3.03	2.72		1.052	
Sarda	hay	623 (B)	4.96	4.56 (a)	4.91	1.921	Brandano et al., 1991
	hay+concentrate	1.077 (A)	4.74	4.11 (b)	5.04	2.308	
Saanen	complete ration with hay	3.036	3.08	3.11			Polidori et al., 1991
	complete ration with treated straw	2.928	3.08	3.01			
	complete ration with treated straw+urea	3.112	2.98	3.10			

Small letters=significant differences per P<0.05.
Large letters=significant differences per P<0.01.

related to the energy given by the ration, the total nitrogen increases in milk, because of the higher non-proteic nitrogen content, filtered by mammary gland (22). The relation between feeding and milk protein content — influencing cheese making yields, but also playing a dietetic and therapeutic action (35), if directly consumed — concerns concentration and kind of ration carbohydrate protein and fat, and feed additive use. Easily fermentiscible sugar concentration is, for some uses, positively correlated with milk protein content (58) (60), for the combined action of: a) the better rumen use of the ration nitrogen; b) the higher production of propionic acid which, releasing amino-acids from liver gluconeogenesis, makes them available for protein synthesis; c) the higher availability of one metabolite (glutamate) which is needed for mammary synthesis of non-essential amino-acids.

Table 9 ***Milk characteristics of the main Italian goat breeds.***

Breed	Fat %		Protein %		Author
	mean	SD	mean	SD	
Maltese	4.17	0.91	3.14	0.62	A.I.A. 1990
Saanen	3.67	1.07	2.97	0.54	A.I.A. 1990
Camosciata	2.81	0.38	2.59	0.26	A.I.A. 1990
Jonica	3.81	0.48	2.94	0.34	Rossi et al., 1988
Sarda	5.79	0.78	4.63	0.57	Brandiano and Piras, 1978

The ration protein concentration influences protein total production, but not the unitary one, even if some authors (4) (69) found small differences.
The protein source is, on the contrary, able to influence milk protein production: fish-meals provoke, conversely to soya-bean meal, the increase of milk protein content (60), depending on their stimulating action on rumen microflora and on their large use in the whole digestive tract; urea, on the contrary, reduces the milk protein content and worsens milk cheese features, because of casein synthesis decrease (69).
Feed fat added usually reduces milk protein content in cattle and sheep species: on the contrary, tests on lactating goats (**table 11**) have not confirmed this effect (10).
Feed additive use, together with other feeding technics, may increase milk protein content, improving the nitrogeno repartition; auxins make rumen fermentations to produce propionate; rumen-protected amino-acids (as methionine) may favour the

mammary protein synthesis (24) both directly and improving liver functioning.

Feeding and meat production

Goat meat production comes by adult goats, but mainly by young animals, that is to say the traditional kid (which is slaughtered at 35-45 days of age, and 8-10 Kg of body weight:) as older kid contribution (weaned and fattened, to be killed at 3-3.5 months and 25-30 Kg of body weight) is marginal and depends on the market demand.

Feeding greatly influences meat production efficiency in goat breeding, as it determines both flock fertility (number of kids per effective-goat) and kids quantities (slaughtering yield, carcass composition, meat quality).

Kid feeding in extensive breedings (16) is only based on the utilization of mother-milk production: after birth, the animal is put in particular boxes, where it spends the whole period, depending on the mother's production level, with one or two suckings per day. Natural suckling, which should be practiced only in meat producing farms and/or in the ones without minimal structures, is strongly conditioned by the mother production level.

Kid feeding in intensive breedings is usually artificial: milk replacer administration systems depend on the personnel's specialization degree and vary from the simple — single or collective — distribution, by buckets with nipples, to electromechanical sucklers. Artificial suckling, by which the kid is not at all dependent on its mother, allows to have, even by selection, a better prolificity and a better exploit kids' growth capacity, till reaching higher slaughtering weights than traditional ones.

Kid breeding researches carried out in Italy (**tables 13, 14** and **15**) have mainly concerned: a) natural suckling tests; b) artificial suckling tests; c) comparison between natural and artificial suckling; d) fattening tests; e) slaughtering tests.

Natural suckling tests show lower average daily growth rates in small and medium

Table 10 ***Chewing time, composition of ruminal VFA, forage intake index and milk production at 8th week of lactation (LU, 1987 cit. Polidori et al. 1991).***

Item	Average lenght of particles (in mm)		Significance
	2.38	3.87	
ADF (% DM)	14.3	13.9	—
Chewing activities (min/d)			
— Eating	219	245	n.s.
— Rumination	364	459	<0.001
— Total	583	704	<0.001
Intake (kg of DM)	1.935	1.774	n.s.
Chewing (min/kg DM)	301	397	—
VFA (in % mole)			
— acetate	57.8	60.8	<0.10
— propionate	26.4	23.6	n.s.
— butyrate	13.4	13.5	n.s.
Intake index			
— Dry matter	2,483	2,756	—
— ADF	488	625	<0.01
Production			
— milk (g)	1,261	1,351	n.s.
— fat (%)	4.7	5.1	<0.10
— protein (%)	3.5	3.5	n.s.

Table 11 ***Effect of rumen-protected fats on goat milk quality.***

Group	Diet fat concentration %	Milk quality		Author
		Fat %	Protein %	
Control	2.3	2.72a	2.74	Lanzani et al., 1985
Treated (*)	5.9	3.01b	2.69	
Control	2.6	3.5A	3.4	De Maria Ghionna et al., 1987
Treated**	6.5	4.5B	3.5	
Control	3.0	3.4A	3.6	Polidori et al., 1989
Treated**	5.8	3.7B	3.6	

(*) Soya oil protected with formaldhyde
(**) Megalac=palmitate-oleate calcium
(***) Calcium soap of animal and vegetable fats

Small letters=significant differences per P<0,05
Large letters=significant differences per P<0,01

Table 12 ***Influence of dietary fats on the goat milk acidic composition.***

Group	C6:0	C8:0	C10:0	C12:0	C14:0	C16:0	C18:0	C18:1	C18:2	Author
Control	2.1	2.8	9.9	4.0	11.2	34.7	7.4	16.4	1.1	De Maria G. et al., 1987
protected fat	2.1	2.4	7.6	2.7	8.5	35.1	7.7	22.8	1.6	
Control	2.2	2.9	11.7	6.6	13.7	32.3	3.5	15.3	3.2	Bartocci et al., 1988
cotton seeds	2.4	2.7	9.4	4.9	11.7	28.0	10.1	19.3	3.4	
Control	2.9	3.0	10.3	3.4	9.7	29.7	7.4	17.9	3.0	Polidori et al., 1989
protected fat	2.8	3.3	12.8	4.7	10.8	28.3	8.4	19.2	3.3	
Control	4.2	....	32,6	....	....	27.2	6.2	18.3	2.8	Falaschini et al., 1989
protected fat	4.5	....	35.0	....	....	27.1	6.0	16.4	2.1	
Extruded soya bean	3.6	....	30.3	....	....	25.3	7.2	20.5	4.2	

Table 13 ***Growth rate and conversion index of suckling kids in some Italian breeds.***

Breed	Suckling	Body weight initial kg	Body weight final kg	Growth rate g/d	FCI kg/kg	Slaughtering age d	Author
Cross breed Maltese	natural	3.200	9.000	136	10.11	40	Montemurro, 1966
Garganica	omologeous	2.783	6.806	114	8.45	35	Di Lella et al., 1973
	artificial	2.755	6.534	108	1.41		
Cross breed Maltese	artificial male	3.255	9.544	140(a)	1.55	45	Lanza, Lanza, 1978
	artificial fermale	3.133	8.912	128(b)	1.61		
Saanen	artificial	5.015	10.180	235	1.105	29	Secchiari et al., 1979
Cross breed Maltese	artificial	4.750	8.840	186	1.235		
Garganica	natural	3.210(b)	8.880(b)	151(b)	6.30(b)	38	Pilla et al., 1982
Maltese	natural	3.500(b)	9.420(b)	159(b)	7.84(a)		
Saanen	natural	4.340(a)	12.500(a)	214(a)	7.18(a)		
Saanen×Sarda	artificial	4.560	8.710	148	1.47	28	Congiu, 1982
	natural	4.290	8.790	160	7.50		
Saanen	artificial+concentrates after 10 d	3.650	11.570	225	milk 1.15 conc. 0.09	35	Bartocci et al., 1986
		3.740	12.940	194	milk 1.39 conc. 0.18	48	
Saanen×Sarda	artificial a libitum	4.480	13.200	246	1.24	35	Congiu, 1986
	artificiale twice/d	3.940	10.390	184	1.47		
	natural	4.58	10.830	178	7.61		
Saanen×Sarda	artificial singles	4.67(A)	16.95(A)	292(a)	total	42	Congiu, 1987
	artificial twins	3.71(B)	14.83(B)	265(b)	1.22		
Camosciata	artificial	4.08	11.29	206	1.118	35	Terzano et al., 1988
Saanen	artificial	4.14	10.68	186	1.192		
Camosciata	artificial	4.01	14.52	210	1.222	50	
Saanen	artificial	4.09	13.24	183	1.325		
Sarda	artificial singles	4.580(A)	18.720	289	total	49	Congiu, 1989
	artificial twins	4.000(B)	17.560	277	1.3		
Saanen	artificial	3.600	10.100	95	1.94	67.8	Andrighetto et al., 19
Camosciata	artificial	4.000	11.500	107	2.17	69.5	
Saanen+Camosciata	artificial fat 19%	4.060	13.050	133(A)	2.01	68.1(a)	Bailoni and Andrighe
	artificial fat 19-23%	3.630	12.190	116(B)	1.95	72.9(b)	
	artificial fat 23%	4.000	13.050	125(AB)	1.97	72.5(b)	
Sarda	natural	3.600	8.937	127	8.31	42	Serra et al., 1989
	artificial	3.167	8.982	137	11.76		

Small letters=significant differences per P<0,05; Large letters=significant differences per P<0.01; FCI=feed conversion.

Table 14 ***Body weight, growth and conversion index of Saanen breed kids fattened with concentrate until 105 days (Maiorana et al., 1984).***

Experimental Factors	Experimental Levels	Body weight initial kg	Body weight final kg	Growth rate g/d	FCI kg/kg
Suckling	artificial	15.810(a)	18.970	113(b)	6.040
	natural	14.390(b)	18.300	140(a)	5.050
Weaning	6 weeks	14.850	19.640(A)	172(A)	4.57(b)
	8 weeks	15.250	17.390(B)	77(B)	6.60(a)
Sex	male	15.540	19.300(a)	134	5.350
	female	14.600	17.840(b)	116	5.870

Small letters=significant differences per P<0,05;
Large letters=significant differences per P<0.01;
FCI=feed conversion index.

Table 15 ***Dressing, percentage and carcass composition of Italian breed kids.***

Breed	Feed	Age d	Body weight kg	Carcass %	Muscle %	Bones-tendon %	Fat %	Author
Cross breed								
Maltese		45	(DBW)					Lanza, Lanza, 1978
	Milk male		9.294	54.50	65.68	24.77	9.55	
	female		8.371	51.51	64.95	25.36	9.69	
Saanen×Sar-da		28	(DBW)					Congiu, 1982
	Substitute milk		8.71	52.40(A)	59.40	32.65	8.37	
	Milk		8.79	46.53(B)	60.58	32.11	7.88	
Saanen	Milk+concentrate+hay	90	21.179	53.93				Ferruzzi et al., 1982
Saanen	Milk+concentrate		(NBW)					Bertocci et al., 1986
		35	10.37	68.64				
		48	12.18	69.95				
Saanen		35	(NBW)			(only bones)		Borghese et al., 1986
	Substitute milk				59.48	29.53	7.74	
	Milk		total	total	57.76	29.26	8.89	
			9.2	68.60				
Saanen×Sar-da		35	(DBW)					Congiu, 1986
	Milk and libitum		13.20	51.93	62.18	31.75	6.23	
	Milk twice/d		10.39	48.37	61.79	32.82	5.81	
Saanen×Sar-da		42	(DBW)					Congiu, 1987
	Milk singles		16.95(A)	52.57	61.14	32.05	7.19	
	Milk twins		14.83(B)	53.68	60.78	32.91	7.12	
Sarda		49	(DBW)					Congiu, 1989
	Milk singles		18.72	53.05	59.85	31.25	9.65	
			17.56	52.97	58.26	32.46	10.05	
			(NBW)					Andrighetto et al., 1989
Camosciata	Substitute milk	69.5	10.30(a)	55.40				
Saanen	Milk	67.8	9.60(b)	56.90				
Sarda		42	(DBW)					Serra et al., 1989
	Milk		8.937	53.25	59.56	29.93	10.51	
	Substitute milk		8.982	49.92	62.91	27.87	9.22	
			(NBW)			(only bones)		Borghese et al., 1990
Camosciata	Substitute milk	35	10.54	68.76				
Saanen	Substitute milk	35	10.30	66.92	59.92	28.52	7.17(b)	
Camosciata	Substitute milk	50	15.02(a)	70.77				
Saanen	Substitute milk	50	12.35(b)	70.00	59.78	27.76	8.76(a)	
Camosciata	Substitute milk	×breed			59.20(b)	28.58	8.36(a)	
Saanen	Substitute milk	×breed			60.51(a)	27.70	7.57(b)	
3/4 Saanen	(Milk or substitute+concentrate)	105	(NBW)					Maiorana et al., 1984
	male		16.40(a)	62.00				
	female		14.94(b)	63.45				
	substitute		15.22	63.33				
	milk		16.16	62.99				
	6 weeks		16.56(A)	64.01(A)				
	8 weeks		14.61(B)	62.35(B)				

DBW=Dressing Body Weight; NBW=Net Body Weight. Small letters=significant differences per P<0,05; Large letters=significant differences per P<0,01.

weight breeds if compared to the heavy ones (g/d 150 vs 200) and lower feed conversion indexes (55) for Garganica, in relation to Saanen and Maltese (6.30 vs 7.18 vs 7.84). This is due perhaps to the higher fat content of maternal milk: the growth rate trend is growing till the second decade age and it starts decreasing from the third on, while the feed conversion index has an opposite trend (51).

Artificial suckling trials show that kids belonging to the main Italian breeds adapt to this kind of breeding, which, for its positive production and sanitary results, allows to reach optimal slaughtering weights, not only in heavy breeds (68) but also in hard ones (40) (65) (29) and in their crossbreds (28).

Concentrates use, to complete milk replacer, would not improve — compared to milk feed — neither the growth rate nor the feed conversion index (9), probably because of gut insufficient functionality; the use of a high lipidic content milk replacer (23% on DM) would not improve growth rate, indeed it would provoke digestive troubles (7).

Comparisons between artificial and natural suckling show that there is no significant differences between them, as for growth rate, while feed conversion index, calculated on dry matter, is lower in natural suckled animals (34) (26) (67), probably because maternal milk is easier to digest. Milk replacer unlimited administration determines higher growths than the ones depending on an administration twice daily and on natural suckling (27), namely with low productive mothers.

Fattening trials show that older kids production features (growth rate and feed conversion index) are influenced by age and weaning, more than on the breeding system (47): an early ingestion of solid feeds in fact helps rumen development and functionality; consequently the feed rations administered after weaning are better used.

Slaughtering trials show that both slaughtering yields and carcass features are influenced — even if not as significantly as for other species — on genetic type, sex, slaughtering age and delivery type (8) (3) (14), probably because kids are not inclined to meat production. If this is a negative aspect, on one hand (low growth rate and high conversion index), it is a positive fact, on the other hand (uniformity of marketable products, low fat content of carcass) (12).

The few researches carried out on meat protein quality and on fat acidic composition show that: proteins having a higher biological value — which are the easily digestible and assimilable to man — are more than in lamb meat (31); as kid tissues keep juvenile features for a longer time, their meat has a higher nutritional value, even when slaughtering age is postponed (31) (66) (48); fats acidic composition may be changed thanks to artificial suckling, to obtain more digestible meats, as a consequence of oleic

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