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in

Rubino R. (ed.), Morand-Fehr P. (ed.).
Production systems and product quality in sheep and goats

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 46

2001
pages 19-28

Influential factors in lamb meat quality. Acceptability of specific designations

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SUMMARY – The sheep sector in the Mediterranean basin is described as well as the productive factors affecting lamb carcass and meat quality. The actual situation of the Protected Designations of Origin (PDOs) in the Spanish market of lamb meat is analysed. Results of a comparative study on carcass quality of the four Spanish lamb types with PDO are presented. Which type of lamb do Spanish consumers prefer? An attempt to answer this question is made through two consumer trials where 22 lamb types produced in Europe, including the 4 Spanish products with PDO, are compared. Spanish consumers tend to prefer what they know from previous experiences and what is produced in a way similar to the traditional one.

Key words: Mediterranean, lamb, quality, carcass, consumer preferences.

RESUME – *"Facteurs d'influence sur la qualité de la viande d'agneau. L'acceptabilité des appellations spécifiques". Le secteur ovin dans le bassin méditerrannéen est décrit comme les facteurs de production affectant la qualité de la carcasse et de la viande. Une analyse de la situation actuelle de l'appellation d'origine contrôlée (AOC) est réalisée pour le marché de la viande ovine en Espagne. Les résultats de l'étude comparative de la qualité de la carcasse sont présentés pour les 4 types de mouton espagnols avec AOC. Quel type de viande ovine préfère le consommateur espagnol ? Afin de répondre à cette question 2 essais de consommateurs réalisés avec 22 types de mouton européens, comprenant les 4 types de produits espagnols avec AOC, sont comparés. Les consommateurs espagnols préfèrent le produit ovin qu'ils connaissent ou celui qui est produit de la même façon que le mode traditionnel.*

Mots-clés : *Méditerrannén, mouton, qualité, carcasse, préférences du consommateur.*

The sheep sector in the Mediterranean basin

The dry weather conditions, irregular topography and cereal based agricultural systems of the Mediterranean basin make sheep a suitable species to take advantage of the natural resources in this area. The contribution of sheep breeding to the final national agricultural income and with respect to the world sheep indicators (Tables 1 and 2) show its great importance, bigger than in the majority of other geographical areas around the world.

Inside the European Union, France, Greece, Italy and Spain have more than 55% of the sheep census and sheep meat production and provide, with Portugal, 99% of the total ewe milk (Table 2).

Differences between sheep breeding in the Mediterranean and Northern Europe are based on weather and ecological conditions. Rainfall is one of the main contributors because it determines the pasture land potential and subsequently the animal productive potential and many productive costs.

The characteristics of the sheep breeds in the Mediterranean, compared with Northern countries in Europe, allow them to be perfectly adapted to the environment and to transform crude products in top quality meat: rusticity, limited meat morphology, small or medium size, higher internal fat amount vs.

subcutaneous fat, long sexual activity and good milk production. With these genetic resources two production systems are ordinary in Southern Europe: (i) milk-meat with lambs slaughtered at ultra-light weights and early ages; and (ii) meat with animals slaughtered at light weights. These systems are described in detail bellow. Mediterranean lamb carcasses have usually low weights (<15 kg) while in Northern Europe they are heavier (>15 kg). This fact makes difficult the exchange of products because the preferences of each market are quite different.

Table 1. World sheep indicators: census and productions (FAO, 1994)

	Heads	Meat (t)	Milk (t)	Wool (t)	Lamb meat/total meat
World (100%)	1,086,601,000	6,886,000	7,981,000	2,665,000	3.53
Mediterranean (%)	17.6	22.0	50.8	11.8	6.8
Europe (%)†	6.7	10.4	7.4	6.7	2.5
Asia (%)†	28.9	31.4	25.8	20.2	2.9
Oceania (%)	18.7	18.5	0.0	43.9	24.2
America (%)	11.5	8.1	0.4	12.1	0.8
Africa (%)†	16.6	9.6	15.6	5.3	8.3

†Contribution of Mediterranean countries (21/202) is not included.

Table 2. European† sheep indicators: census and productions (FAO, 1994)

	Heads	Meat (t)	Milk (t)	Carcass weight (kg)	Lamb meat/total meat
Europe (100%)	130.692.000	1.242.000	2.608.000	16.5	3.02
EU/E	56.6	1.7	71.9	17.0	3.05
EUM/EU	59.6	55.4	99.9	11.2	3.70
EUR/EU	40.4	44.6	0.1	20.2	2.50
Spain/EUM	39.4	40.8	16.0	11.0	6.05

†E: Europe; EU: European Union; EUR: European Union countries excluding France, Greece, Italy, Portugal and Spain; EUM: European Union Mediterranean countries (France, Greece, Italy, Portugal and Spain).

Factors which affect lamb meat quality

Many stages are necessary for the meat to be eaten by the consumer. Since the beginning: there must be animals in the farm under a proper reproductive handling to produce offspring; the offspring has to be reared under good conditions and fed correctly, once they reach certain liveweight or age they are transported to the abattoir where they are slaughtered; carcasses are dressed, refrigerated and processed or jointed, afterwards meat is marketed and finally sold to consumers to be cooked and consumed.

In each stage a great diversity of factors may affect the quality of the product at both levels, carcass and meat, as it is shown in Table 3. Apart from the reported factors there are many others as diverse as: the age and milk capacity of the ewe, dam size, type and time of birth, exercise, type and quality of litter, flock, production system, type of cuts and jointing, packaging and presentation, conditions of consumption (temperature of the product, seasoning), etc.

From Table 3 it is easy to deduce that intrinsic and productive factors exert their influence mainly on carcass quality. These factors can be controlled by the farmer and the technician on the farm. However, pre and post slaughter, marketing and consumption factors principally affect meat quality and they just can be controlled by the abattoir, marketing chain and consumers.

Table 3. Factors affecting lamb carcass and meat quality† (source: Sañudo, 1998a)

	Dressing (%)	Carcass quality			Meat quality				
		Weight	Conformation	Fatness	WHC juiciness	Colour	Tenderness	Flavour	Overall
Intrinsic factors									
Breed	**	***	****	***	*	*	*	0	*
Individual and genes	**	**	****	**	0	*	***	0	**
Sex	**	***	**	***	0	*	*	*	**
Weight-age	***	****	*	****	*	***	**	**	***
Productive and environmental factors									
Ambient-season	*	***	0	**	0	*	*	0	*
Feeding	***	***	*	****	*	**	*	**	**
Additives	*	**	**	****	***	*	***	*	***
Pre and slaughter factors									
Fasting, stress and transport	****	*	0	0	**	***	**	*	***
Slaughtering	**	**	0	*	*	**	*	**	*
Post-slaughter and commercialisation									
Ageing	0	0	0	0	**	****	****	**	***
Electrical stimulation	0	0	0	0	**	*	***	*	**
Carcass chilling	**	*	0	0	*	*	***	*	**
Conservation	0	*	0	0	***	***	****	***	****
Consumption factors									
Cooking	0	0	0	***	****	****	****	****	****
Cultural background	0	***	**	****	*	***	*	****	****

†No influence (0), little influence (*), moderate influence (**), high influence (***), fundamental (****).

All these factors indicate that in order to obtain a quality product all the production-marketing-consumption steps have to be carefully attended. Farmers must be implied in the whole process as well as the next links in the *product obtaining chain*, helping in the achievement of the product tractability. In this sense the PDOs (Protected Designations of Origin) are the best approaches of a product obtaining system that can be found actually because they control the rearing and production at the farm, the slaughtering and dressing procedures and carcass and meat characteristics.

Sheep products in Spain: Protected designations of origin

Spain is a country with around 500,000 square km but with a great ecological and environmental variety which has given rise to different productive systems and products.

In the Spanish market of lamb meat is easy to find such different products as:

(i) Suckling lamb, "lechal" or "lechazo": which represents between 11 and 15% of total sheepmeat in the markets. Carcass weight is the lightest available: less than 7 kilos. They come from milk farms located mainly in the Northern half of Spain and in the Canary Islands where the breeds used are: Churra, Lacha, Ojalada, Castellana, Manchega and Canaria. The animals are fed practically exclusively ewe's milk until slaughter which takes place early, about 25-45 days.

(ii) Light lamb "ternasco", "recental" and "pascual": is the most frequent product (68-75%) in the Spanish market with a carcass weight between 8.5 and 13 kilos. There are two different basic types in this group:

- "Ternasco" or "recental": produced mainly in the centre and eastern half of Spain from medium-fine wool sheeps. Lambs can be weaned after 40-55 days or not, they are fed concentrate *ad libitum* until the slaughter at 70-100 days of age. "Ternasco" refers to carcasses weighting between 8.5 and 11.5 kg meanwhile "recental" denomination could be used for slightly heavier animals with carcass weights about 11-13 kg.
- "Pascual": obtained from Merino breed and other ethnic groups of Southern and Western Spain. Animals stay with their mothers in the pasture and they are finished in fattening units using concentrates at 4-6 months of age and 12-14 kg carcass weight. Recently this production system is changing: lamb are weaned earlier (40-50 days) and transferred to feedlots from where they are sold as "ternasco" or "recental" types.

(iii) Early fattening lamb or "cordero de cebo precoz", heavy fattening lamb or "cordero de cebo pesado", grazing lamb or "pastenco" and old sheep or "ovino mayor" comprise the rest of the Spanish sheep meat market (10-21%) which means that each individual group is not very relevant. In general those products come from older and heavier animals and are less appreciated by Spanish consumers than the previous groups.

Apart from the wide range of lamb meat products described previously, in the last 10 years lambs with PDOs have appeared in the national market. The PDOs were created in order to fight against imported lambs sold at cheaper prices, to defend and warrant the quality of regional products and to promote subsequently the national sheep sector by increasing lamb consumption and satisfying consumer demand.

Nowadays it is possible to find 4 lamb products with quality marks in the Spanish market. Starting from the lightest: "Lechazo de Castilla y León" with IGP (protected designation of origin) which reflects the suckling lamb, followed by "Ternasco de Aragón" with IGP, "Cordero Manchego" with DE (specific designation) and "Cordero de Extremadura" with DE representatives of the light lambs produced in different Spanish regions. There are also another proposal for the future, as "Cordero de Navarra" which is going to appear soon, showing the arising interest of the quality in the national sheep sector. The specifications of the 4 quality marks are presented in Table 4.

A deep study with these products has been carried out in the European Union founded project FAIR3-CT96-1768, some results on carcass quality are presented here.

Table 4. Main characteristics of the Spanish lambs with quality marks

	Ternasco de Aragón	Cordero Manchego	Cordero de Extremadura	Lechazo de Castilla y León
Order	Order 22/9/1992 BOE No. 239 5/10/1992	Order 19/9/1996 BOE No. 246 11/10/1996	Order 9/4/1997 DOE No. 44 15/4/1997	Order 28/5/1997 BOC y L No. 107 6/6/1997
Breeds	Rasa Aragonesa, Ojinegra, Roya Bilbilitana	Manchega	Merino ewes Merino, early Merino, Ile de France, Fleischschaf rams	Churra, Castellana, Ojalada
Sex	Not castrated males and females	Not castrated males and females	Males and females	Without distinction concerning sex
Age at slaughter (days)	70-90	60-90	<80	<35
Carcass weight (kg)	8.5-11.5	10-14	Males 10-14 Females 9-11	4.5-7 (with omental fat)
Feeding system	Ewe's milk at least 50 days, concentrate, white straw *ad libitum*	Ewe's milk at least 30 days, concentrate, white straw *ad libitum*	Ewe's milk until 15 kg live weight, concentrate, white straw *ad libitum*	Ewe's milk. Not weaning

Protected designation of origin: Carcass quality

One hundred twenty carcasses from entire male animals of each PDO were taken from EU licensed abattoirs. Cold carcass weight was recorded individually. Fatness and colour of these carcasses were also evaluated according to the European Classification System for light carcasses (EEC Regulation No. 2137/92, No. 461/93) and conformation score was given following the proposal of Colomer (1984). Mean values are reported in Table 5.

Table 5. Weight, fatness, conformation and colour scores of Spanish carcasses with Protected Designation of Origin

	Cold carcass weight (kg)	Fatness score†	Conformation score††	Colour score†††
Ternasco de Aragón	10.118^{b} (0.64)	2.48^{b} (0.69)	1.60^{b} (0.51)	1.97^{b} (0.18)
Lechazo de Castilla y León	5.508^{a} (0.46)	1.97^{a} (0.48)	1.00^{a} (0.00)	1.09^{a} (0.29)
Cordero de Extremadura	13.278^{d} (0.78)	2.63^{b} (0.66)	2.01^{d} (0.01)	2.10^{c} (0.30)
Cordero Manchego	11.957^{c} (0.79)	2.52^{b} (0.64)	1.77^{c} (0.48)	1.93^{b} (0.36)
Significance	***	***	***	***

†Very slight (1), slight (2), average (3), high (4).
††Poor (1), ordinary (2), regular (3), very good (4), excellent (5).
†††Light pink (1-2), pink (3-4), other colour (5-6).
*** P<0.001.
^{a,b,c,d}Means in the same column with different superscript letters are different.

Comparisons made between types reveal cold carcass weight and conformation score as the main criteria which differentiate the 4 PDOs products being "Lechazo de Castilla y León" the lightest and having a poor conformation score followed by "Ternasco de Aragón" and "Cordero Manchego" in intermediate positions and finally "Cordero de Extremadura" which has the highest carcass weight and an ordinary conformation score.

Variations in colour between lamb types also exist. Colour scores of "Ternasco de Aragón" and "Cordero Manchego" do not differ significantly but they are intermediate and significantly different from the colour scores of "Lechazo de Castilla y León", the lowest, and "Cordero de Extremadura", the highest.

Fatness scores of the four lamb types are not as different as the carcass traits described previously. Just "Lechazo de Castilla y León" differs significantly from the other three types having the lowest fatness score. While this product has a fatness level between very slight and slight, the other types range higher, between slight and average.

In Table 5 the mean values and standard deviations reveal a high homogeneity within each lamb type. The four types, compared with other lambs from Northern Europe, are light lambs (cold carcass weight 13 kg) with poor or regular conformation, light pink colour and a fatness level under average according with the European grading system.

Carcass and leg length, width and circumference of buttock as well as chest depth were measured on each carcass (Sánchez *et al*., 1998; Alfonso *et al*., 1999) but results are not presented here. Carcass length has been used to compute the compactness index shown in Table 6.

Ten left half carcasses of each lamb type representatives of all fatness levels (low, medium, high) were dissected following the methodology proposed by Fisher and De Boer (1994) and tissular composition, expressed as percentage, is detailed in Table 6.

Table 6. Compactness index and tissular composition of Spanish carcasses with Protected Designation of Origin

	Compactness index† (kg/cm)	Bone (%)	Lean (%)	Fat (%)	Other tissues (%)
Ternasco de Aragón	0.19^{b}	20.41^{a}	63.22^{b}	14.49^{a}	1.88^{a}
	(0.01)	(1.55)	(1.97)	(3.26)	(0.26)
Lechazo de Castilla y León	0.13^{a}	22.55^{b}	58.77^{a}	16.51^{ab}	2.17^{a}
	(0.01)	(1.70)	(1.88)	(3.46)	(0.17)
Cordero de Extremadura	0.24^{c}	19.95^{a}	57.44^{a}	19.54^{b}	3.07^{b}
	(0.01)	(1.05)	(3.26)	(3.85)	(0.39)
Cordero Manchego	0.21^{d}	23.48^{b}	57.63^{a}	15.97^{ab}	2.92^{b}
	(0.01)	(1.45)	(2.25)	(3.27)	(0.50)
Significance	***	***	***	*	***

†Compactness index = cold carcass weight (kg)/carcass length (cm).
*P<0.05, ***p<0.001.
^{a,b}Means in the same column with different superscript letters are different.

In Table 6 compactness index shows the same pattern as carcass weight and conformation. From the lowest to the highest index differing significantly: "Lechazo de Castilla y León", "Ternasco de Aragón", "Cordero Manchego" and "Cordero de Extremadura".

Tissular composition (%) of the carcasses is also significantly different in the four PDOs. "Ternasco de Aragón" has the highest lean percentage and the lowest bone and fat percentage indicating that the slaughter age and weight are optimum in order to maximise the lean amount which is the most valuable tissue in the carcass. Studies done on carcass quality of this type of lamb, as well as the genetic improvement achieved in the recent years, have contributed in this sense.

"Cordero de Extremadura" has the same bone percentage as "Ternasco de Aragón", the same lean percentage as "Lechazo de Castilla y León" and "Cordero Manchego", but the highest fat percentage. These lambs are in the highest weight range and were the oldest at the moment of slaughter, both facts have probably contributed to reach superior physiological development implying a higher deposition of adipose tissue if compared with the other lamb types. Slaughtering at younger ages or lower weights could reduce fat percentage favouring an increase in lean percentage.

"Lechazo de Castilla y León" and "Cordero Manchego" show a not significantly different tissular composition of the carcass (lean, bone and fat percentage). The first ones have been slaughtered at younger ages and lighter carcass weights, but they belong to a smaller format and earlier maturing breed than Manchega and, in addition, they have consumed ewe's milk which is a high energetic food which promotes fat deposition. All these conditions together make fat percentage in suckling lambs to be higher than in "Ternasco de Aragón" and similar to that in "Cordero Manchego", both weaned.

In summary: carcass weight, appearance and tissular composition of the four Spanish lambs with PDO differ and this is due to the contribution of multiple factors, mainly productive, which are defined by the regulations of each PDO.

If an analysis of this information is done from two different viewpoints (European vs. national) it is possible to conclude that:

(i) From the European point of view the four products represent a unique group of light, pale, lean and poorly conformed carcasses typical from the Mediterranean area (Esteban, 1997).

(ii) From the Spanish point of view the four products can be differentiated firstly according to the carcass weight and conformation, secondly to the colour and finally to the fatness score. As our national carcass market rewards low weight, pale meat and not very high fatness level, "Lechazo de Castilla y León" seems to meet fully these requirements, as it is reflected by its higher prices compared with the other light lambs (585 ptas/kg liveweight vs. 379 ptas/kg liveweight in 1995) (MAPA, 1997).

Protected designation of origin: Consumer acceptability

Carcass quality is not directly perceived by the consumer because lamb is normally consumed in cut or joints and not as a whole carcass. In addition, what consumers note is the quality of meat they eat. But, how lamb meat can be described of good or bad eating quality? The concept of quality is relative and subjective and it is defined by the consumer, changing in the space and time.

In an attempt to understand the preferences of Spanish consumers regarding lamb meat two trials were carried out. In the first trial "Ternasco de Aragón" and "Lechazo de Castilla y León" were tested with another 10 types of lambs reared in traditional production systems in Europe: suckling lambs from Greece (type 7), concentrate fed reared indoors light lambs from France, Greece and Italy (types 6, 8, 12), pasture fed lambs from extensive systems of United Kingdom, Northern France and Iceland (types 1, 2, 5, 9, 10) and transhumant one year old animals from Italy (type 11). In the second trial the other two Spanish lambs with quality marks were examined: "Cordero de Extremadura" and "Cordero Manchego" together with other concentrate indoors fed animals from Greece (type 18), grass fed animals from UK, Greece, Iceland and Italy (types 13, 17, 19, 20, 21) and a last group of lambs fed with both grass and concentrate from UK and Italy (types 14, 22).

Animals were slaughtered in EU abattoirs following the same procedures. Carcasses were kept for 6 hours at 10°C before freezing to avoid cold shortening. 24 hours post-slaughter legs were excised from the carcasses and vacuum-packed. The ageing period of the meat was 6 days at 2°C before blast freezing at -20°C.

In both trials 36 families from the urban area of Zaragoza (Spain) participated roasting, consuming and doing an hedonic evaluation of one leg of each lamb type; in definitive, each family tasted all the lamb types available in each phase without any information about the origin of the samples.

The families comprised 3 or more persons older than 16 years and used to eat lamb meat. They

received a frozen lamb leg weekly and were told to thaw it slowly (48 hours in the fridge) and to roast it in a conventional oven (not microwave). The cooker was the only person who assessed the odour while roasting in a 0-10 scale; anchor points were labelled 0 "dislike extremely" and 10 "like extremely". The same hedonic scale was utilised by the other members of the family to evaluate flavour, texture, juiciness and overall liking.

A total around 180 consumers collaborated in each trial. Mean scores and standard deviations of each lamb type are presented in Table 7 and 8. As the correlation coefficients between attributes are very high (ranging from 0.8 to 0.9) and overall liking resumes the general acceptability of the meat, the following discussion is based on it.

Table 7. Hedonic evaluation (means and standard deviations) of 12 different lamb products by Spanish consumers. First trial

Lamb product	Odour while cooking†	Flavour†	Texture†	Juiciness†	Overall liking†
1	5.33^{ab}	5.36^{ef}	5.11^{ef}	4.86^{fg}	5.18^{fg}
	(2.26)	(2.39)	(2.37)	(2.44)	(2.44)
2	5.29^{ab}	5.64^{cdef}	5.46^{def}	5.40^{defg}	5.57^{defg}
	(2.35)	(2.41)	(2.28)	(2.44)	(2.33)
3: Ternasco de	7.13^{ab}	7.28^{ab}	7.17^{ab}	7.11^{ab}	7.41^{ab}
Aragón	(2.00)	(1.78)	(1.58)	(1.73)	(1.47)
4: Lechazo de	7.29^{a}	7.50^{a}	7.44^{a}	7.60^{a}	7.65^{a}
Castilla y León	(1.86)	(1.80)	(1.85)	(1.89)	(1.81)
5	5.14^{ab}	5.58^{def}	5.44^{def}	5.11^{efg}	5.46^{efg}
	(2.13)	(2.12)	(2.12)	(2.25)	(2.14)
6	6.38^{ab}	6.33^{bcde}	6.15^{bcde}	6.15^{bcde}	6.33^{bcde}
	(2.27)	(2.27)	(2.29)	(2.32)	(2.33)
7	6.52^{ab}	6.73^{abc}	6.76^{abc}	6.73^{abc}	6.88^{abc}
	(2.11)	(1.90)	(1.92)	(1.99)	(1.82)
8	6.57^{ab}	6.66^{abcd}	6.41^{abcd}	6.38^{bcd}	6.63^{abcd}
	(2.27)	(2.25)	(2.28)	(2.32)	(2.28)
9	5.76^{ab}	5.91^{cdef}	5.73^{cdef}	5.62^{cdef}	5.88^{cdefg}
	(2.11)	(2.11)	(2.18)	(2.39)	(2.29)
10	5.40^{ab}	5.60^{def}	5.62^{def}	5.49^{defg}	5.67^{defg}
	(2.04)	(2.23)	(2.25)	(2.27)	(2.24)
11	4.87^{b}	5.01^{f}	4.69^{f}	4.44^{g}	4.80^{g}
	(2.41)	(2.34)	(2.27)	(2.32)	(2.35)
12	6.11^{ab}	6.16^{cde}	5.98^{cde}	5.97^{cdef}	6.21^{cdef}
	(2.09)	(2.22)	(2.27)	(2.37)	(2.25)
Significance	***	***	***	***	***

†Scores: dislike extremely (0), like extremely (10).
***P<0.001.
^{a,b,c,d,e,f,g}Means in the same column with different superscript letters are different.

In the first trial there is a clear preference for the Spanish lambs "Lechazo de Castilla y León" and "Ternasco de Aragón" followed by lambs reared in similar production systems typical in the Mediterranean area, suckling lambs and concentrate indoors fed animals (types 7, 8, 6, 12). The less preferred lambs were those grazing pasture, generally heavier and older (types 9, 10, 2, 5, 1, 11).

Results in the second trial confirm the previous ones: type 18, "Cordero Merino" and "Cordero Manchego", which are lambs eating concentrate and reared intensively as is common in Southern Europe, have higher acceptability scores than those grazing forages or both forages plus concentrate. Inside the grass fed lambs, the lighter animals (<15 kg carcass weight, types 13 and 19) are better evaluated than the heavier ones. The Italian lambs, type 21 and 22, from the same breed as type 11 in the first trial, were the worst accepted confirming again the results in the previous experience.

Table 8. Hedonic evaluation (means and standard deviations) of 10 different lamb products by Spanish consumers. Second trial

Lamb product	Odour while cooking†	Flavour†	Texture†	Juiciness†	Overall liking†
13	6.22 (2.12)	6.29^{abcd} (1.93)	6.28^{abcd} (1.98)	6.30^{abc} (2.08)	6.38^{abcd} (1.98)
14	5.52 (1.78)	6.21^{abcd} (1.80)	5.97^{abc} (1.96)	6.06^{ab} (2.00)	6.19^{abc} (1.91)
15: Cordero de Extremadura	6.86 (2.04)	6.92^{cd} (1.72)	6.92^{d} (1.71)	6.81^{bc} (1.80)	6.92^{cd} (1.76)
16: Cordero Manchego	6.75 (1.91)	6.79^{bcd} (1.94)	6.85^{cd} (1.99)	6.78^{bc} (2.09)	6.92^{cd} (1.98)
17	5.94 (2.10)	6.23^{abcd} (1.98)	6.17^{abcd} (1.99)	6.21^{abc} (2.04)	6.20^{abc} (1.95)
18	6.83 (1.53)	6.96^{d} (1.75)	7.03^{d} (1.59)	7.05^{c} (1.64)	7.15^{d} (1.56)
19	6.18 (1.79)	6.52^{abcd} (1.99)	6.55^{bcd} (1.79)	6.27^{abc} (2.05)	6.52^{bcd} (1.90)
20	5.64 (2.19)	6.06^{abc} (1.98)	5.89^{ab} (1.99)	5.84^{a} (1.86)	6.06^{abc} (1.84)
21	5.25 (2.23)	5.74^{a} (2.41)	5.43^{a} (2.18)	5.49^{a} (2.19)	5.59^{a} (2.37)
22	5.25 (2.13)	5.95^{ab} (1.99)	5.87^{ab} (2.05)	5.70^{a} (2.22)	5.94^{ab} (1.99)
Sig. 2	***	***	***	***	***

†Scores: dislike extremely (0), like extremely (10).
***P<0.001.
^{a,b,c,d}Means in the same column with different superscript letters are different.

In the conditions of these studies it could be concluded that:

(i) The different European lamb types are, in general, well accepted by the Spanish consumers. Scores vary from 4.80 in the less preferred to 7.65 in the most appreciated.

(ii) Spanish consumers are able to distinguish between lamb types according to the production system in which they are reared.

(iii) Spanish consumers prefer home reared products and meat from lambs obtained in a similar way as is common in Spain: suckling lambs and concentrate intensively fed animals.

After these conclusions some questions arise: why do Spanish consumers prefer these lamb types and not the grass fed animals? is it because ones are better than the others? And what is better? or is it just because they are used to consume these types of lambs and they know them? does a trend to refuse unknown products exists?

In this sense Griffin *et al*. (1992) revealed how two untrained sensory panels (foreign and domestic) scored differently the same samples, sheep and goat loin chops and leg steaks. Palatability ratings of foreign panellists were generally higher than were those by domestic panellists. The authors suggest that domestic panellist may not be capable of assessing "desirability" of product as it would be perceived by foreign consumers. Also, in a previous study (Sañudo, 1998b) two trained sensory panels, Spanish and British, evaluated the meat from the same Spanish and British lambs. Both panels were in full agreement in the objective assessments of the meat: tenderness, juiciness, flavour and odour intensity, but when they were asked for their preferences (flavour and overall acceptability) the Spanish panel preferred the Spanish meat and the British panel preferred the British meat. In both cases there was a clear influence of the cultural background and previous experiences or knowledge affecting the preferences of the panels.

Acknowledgements

We gratefully acknowledge to our research fellows in the European Project FAIR3-CT-1768, the Regulatory Councils of "Ternasco de Aragón", "Lechazo de Castilla y León", "Cordero de Extremadura" and "Cordero Manchego", COLEAR (Cooperativa del Lechazo de Aranda), National Breeders Associations of Merino and Manchega breeds, J.J. Pardos, J.F. Pardos, A. Sánchez, I. Sierra, R. Delfa, F. Lahoz.

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