

QUALITY PERCEPTION OF LIGHT LAMB CARCASS

PERCEPCIÓN DE LA CALIDAD DE LA CANAL DE CORDERO LIGERO

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ADDITIONAL KEYWORDS

Grading systems. Hedonic prices. Conjoint analysis.

PALABRAS CLAVE ADICIONALES

Sistemas de clasificación. Precios hedónicos. Análisis conjunto.

SUMMARY

This article presents an empirical study focusing on the valuation, perception and management of live lamb and carcass quality. The analysis has been performed using the hedonic technique with data collected in a slaughtering house from live animals and carcasses, and applying conjoint analysis to data from butcher shop surveys. The results from the hedonic technique and the conjoint analysis show that the main quality attributes are fat content, carcass weight and meat color. The management of quality to adapt and adjust the product to market requirements, should focus on these factors that determine the evaluation of utility by users. Two other aspects examined are the possibility of live classification to predict market prices and the commercial adaptation of carcass grading systems.

y gestión de la calidad del cordero en vivo y en canal. El análisis se ha llevado a cabo utilizando la técnica hedónica con datos recogidos en un matadero de animales en vivo y en canal, y aplicando el análisis conjunto a datos procedentes de encuestas a carnicerías. Los resultados de la técnica hedónica y del análisis conjunto muestran que los principales atributos de calidad son el grado de engrasamiento, el peso en canal, y el color de la carne. La gestión de la calidad para adaptar y ajustar el producto a las necesidades del mercado, debe centrarse en estos factores determinantes de la evaluación de la calidad por los usuarios. Otros dos aspectos que se han examinado en el trabajo son la posibilidad de utilizar la clasificación en vivo para predecir los precios de mercado, y la adaptación comercial de los sistemas de clasificación de canales.

RESUMEN

Este artículo presenta los resultados de un estudio empírico sobre la valoración, percepción

INTRODUCTION

A comprehensive evaluation of the Spanish lamb quality is important in

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order to contribute to the definition of a grading system for lamb quality, representative of the Spanish market situation. This research requires a review of the sheep market in Spain, the concept of quality applied to live lamb and carcass, and the theory of the hedonic technique; and details about these aspects of the work can be found in Cunhal-Sendim *et al.* (1996). The hedonic technique is the main technique used in this study (Lancaster, 1966; Ladd and Suvannunt, 1976).

The hedonic technique is used to analyze the following topics: i) the market value of the lamb carcass characteristics and quality attributes; ii) the efficiency of commercial grading systems for live lamb; and iii) the adaptation to the market of the main grading systems for light lamb carcass. The study of the lamb quality characteristics has been completed with a survey to butcher shops in the Zaragoza region (Spain), and the survey information has been analyzed by conjoint analysis. The objective of the study is to show the importance of quality management, which must involve every stage of production: live lamb, carcass, and meat production activities.

Another objective of the study is to evaluate the explaining ability of four qualitative characteristics of the live animal, on the carcass price formation. The prediction of the carcass value from observed attributes in the live animal is very important, and is related to the possibility of developing and applying grading and valuation systems on live animals. The growing volume of transactions of live animals in the European Union, and more

demanding markets are reasons that justify the use of these systems.

The last question analyzed is the utility of carcass classification systems, considering the adaptation of two light carcass classification systems. The sheep carcass classification systems are a key element in the EU sheep sector, not only for a better operation of the EU regulations, but also to achieve a more efficient and competitive commercial environment, facilitating the market transparency and the flow of information between market agents.

MATERIALS AND METHODS

The quality perception of the light lamb carcass is examined using three different data collecting techniques (direct observation, attitude scales, and surveys) and three methodologies (hedonic technique, conjoint analysis, and statistical description). The purpose is to assess the importance of the different characteristics and qualitative attributes of light lamb carcass, in the process of forming the utility judgment by consumers or users.

The hedonic technique has been applied previously to beef (Jarrat, 1988; Woods, 1990; Menkhaus *et al.*, 1993), pork (Voon, 1993; Walburger and Foster, 1994) and lamb markets (O'Connell, 1986). In order to find empirically the importance of quality in the market, a large database of lamb sales data provided by a company has been explored. Subsequently, the hedonic technique has been applied to data collected experimentally from 600 light lamb alive and in carcass.

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Lamb sales data were examined through a preliminary analysis using the hedonic technique, in order to assess the relationship between the observed price of 44,000 lamb carcasses slaughtered in 1994, and three types of factors: carcass quality factors, temporal factors and commercial factors. This first empirical analysis was very important for designing and understanding the subsequent hedonic analysis on carcass quality characteristics. Then experimental data were collected from 600 light lambs slaughtered from November 1994 to February 1995 in the Mercazaragoza slaughterhouse (Zaragoza, Spain)¹. During these months lambs were measured and classified alive using the Body Condition Score (Russel *et al.*, 1969), and also in carcass using the Community scale for carcass classification of light lamb (Council Directive 92/2137/EEC). The selling price was observed in order to capture the importance of characteristics in price formation. The specification of the hedonic equation has been linear, with price depending on qualitative, temporal and commercial variables, and estimation has been performed using the Shazam econometrics package.

The second approach has been performed with data collected from butcher shops (90 butcher shops in Zaragoza, Spain), using attitude scales to gather information about their preferences. These preferences have

¹The experimental data were collected six times during the four months period, which are identified in the hedonic regressions as Experiment 1 to Experiment 6.

Table I. Characteristics and levels used in conjoint analysis. (Características y niveles considerados en el análisis conjunto).

Levels	Weight	Characteristics	
		Fat content	Meat color
1	9.6 kg (9-10.3)	1 a 1+ (lean)	Very light
2	10.9 kg (10.3-11.6)	2+ a 3 (medium)	Pink
3	12.1 kg (11.6-13)	4 a 4+ (fat)	Dark

been examined by conjoint analysis (Green and Srinivasan; 1978, 1990), applying the Conjoint Designer package. The experimental design includes the three more important characteristics in valuing the utility of a light carcass: *fat content*, *carcass weight* and *meat color*. The selection of these characteristics and their levels were made based on experts' opinion, the review of the literature, and the results of previous analysis (**table I**). The stimuli were presented as whole profiles using photographs and text, and these data were collected as part of a larger survey. The survey was also used to collect information on commercial practice aspects, perception of carcass and meat quality by butchers, and opinion on meat and carcass grading systems. The models used in conjoint analysis to estimate the aggregated utility function are the ideal-point model and the part-worth function model. The relative importance of each qualitative attribute in the formation of the

Table II. Hedonic price model for the characteristics of lamb carcass. (Modelo de precios hedónicos de las características de la canal de cordero).

Variables	Change	Effect on price (Pta)	t
<i>Carcass weight (kg)</i>	Increase of 1 kg	-14.738	-2.357 ^b
<i>Fat content 1</i>	Classified in	-249.910	-6.134 ^a
<i>Fat content 3(-)</i>	Classified in	+16.941	1.105
<i>Fat content 4</i>	Classified in	-48.465	-1.216
<i>Muscle color - Light pink</i>	Classified in	+11.921	0.955
<i>Conformation status O(-)</i>	Classified in	+29.91	2.121 ^b
<i>Conformation status O(+)</i>	Classified in	-19.30	-1.095
<i>Fat color - Cream</i>	Classified in	-51.527	-1.740 ^c
<i>Pelvic-renal fat - Normal (-)</i>	Classified in	+11.207	0.734
<i>Pelvic-renal fat - A lot (-)</i>	Classified in	-55.731	-0.993
<i>Experiment n° 4</i>	Observed in	-9.224	-0.602
<i>Experiment n° 6</i>	Observed in	+68.365	4.454 ^a
<i>Irregular client</i>	Type of client	-26.412	-1.149
<i>Regular client of high volume</i>	Type of client	-53.261	-3.535 ^a
Constant		899.059	13.132
Average price (pta)	733.70	F	9.224
No Observations	100	Condition index	41.54
Adjusted R ²	0.5377	Durbin Watson	1.829

^aSignificant at 1 percent; ^bSignificant at 5 percent; ^cSignificant at 10 percent; 166,4 pta = 1 Euro.

The variable *carcass weight* has some collinearity with other variables, as detected by the condition index. The equation was reestimated eliminating this variable, yielding similar estimated coefficients. See Cunhal-Sendim *et al.* (1996) for a thoroughly discussion of the question.

utility judgment, is based on the estimated parameters for each attribute.

RESULTS AND DISCUSSION

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Estimation of the hedonic equation confirms the influence of qualitative variables on prices. The results show that the *fat content* is the most important qualitative characteristic in the cool carcass. This factor plays an essential

role in explaining the formation of the carcass price. A strong depreciation is observed when fat content is low. Observation of fat content 1 (the lowest), implies a depreciation around -250 pta/kg carcass (166.4 pta = 1 Euro). An excessive fat content is also penalized but less than lack of fat; fat content 4 (the highest) is associated with a depreciation around -50 pta/kg. There is a premium for intermediate levels of fat content, and fat content 3 has an additional value of 17 pta/kg

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Table III. Utility model for lamb carcasses: quadratic specification. (Modelo de utilidad de las canales de cordero: especificación cuadrática).

$$\text{Utility} = \text{constant} + a \cdot (\text{attribute}_i) + b \cdot (\text{attribute}_i)^2 + \dots$$

Attribute	Coefficient a	Coefficient b	Graphic representation
<i>Fat content</i>	61.155	- 13.733	
<i>Meat color</i>	- 16.575	2.58	
<i>Carcass weight</i>	4.466	- 2.317	

over fat content 2 (**table II**).

The attribute *carcass weight* has also a very significant effect on price. This characteristic has a strong relationship with the other observed quality characteristics. The marginal implicit value of carcass weight is -14.7 pta/kg carcass, displaying a negative relationship between weight and carcass price. The variables *meat color* and *carcass conformation* show little variation, and that prevents to derive sound conclusions about their behavior². The characteristic *fat color* appears as important in explaining carcass price; *white* fat color is associated with the mean price and *cream* fat color presents a depreciation

of around -50 pta/kg. The variable *pelvic and renal fat amount* shows a slight premium for low renal fat (11 pta/kg) and a strong depreciation for high renal fat (-55 pta/kg).

The estimation results from the hedonic equation are used to describe the carcass profile that has the higher value in the market with respect to quality characteristics. The profile corresponds to a carcass weighting

²The effect of conformation on prices is positive in North European countries (O'Connell, 1986), but the effect is not so evident in light carcass Mediterranean markets. Furthermore, no sound conclusions can be derived from the regression, because the variable conformation shows little variation in the experimental data.

Table IV. Utility model for lamb carcasses: part-worth specification. (Modelo de utilidad de las canales de cordero: especificación *part-worth*)

Utility = constant + a . (level _{ij}) + b . (level _{j+1 i}) + c . (level _{j+2 i}) + ...				
Attribute Level	Coefficients	Range	Relative importance	Graphic representation
<i>Fat content</i>				
Lean	- 10.8	19.9	47.5 (p.100)	
medium	9.2			
fat	1.6			
<i>Meat color</i>				
Very light	7.1	12.5	29.7 (p.100)	
pink	-1.7			
dark	-5.4			
<i>Carcass weight</i>				
9.6	4.1	9.6	22.8 (p.100)	
10.9	1,5			
12.1	- 5.6			
Total	0	42	100 (p.100)	

9.2 kg, with middle fat content, white fat color, and reduced amount of pelvic and renal fat.

The second approach is based on conjoint analysis, and **tables III and IV** present the estimation results from the quadratic and part-worth specifications. The preferences of butchers imply that the attribute *fat content* is the main qualitative characteristic in the formation of the carcass utility value. The results show a high utility level for intermediate fat content, low utility for elevated fat content, and very low utility for scarce fat content. The attribute *meat color* appears as second in importance, where *clear* is

associated with high utility, *pink* is less preferred, and *dark* is the least. *Carcass weight* appears as third in importance, although it should be noted that the analysis focuses on light lamb carcass, which is defined by a short range of weight variation. The profile for the ideal product is very close to the profile identified in the market with the hedonic technique. The most preferred carcass is a carcass with intermediate fat content (2+ to 3), very clear color, and a carcass weight between 9 and 10.3 kg. The calculation of the preferred levels of attribute for each butcher indicates a quite heterogeneous individual perception of quality

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Table V. Hedonic price model for the characteristics of live lamb. (Modelo de precios hedónicos de las características del cordero en vivo).

Variables	Change	Effect on price (Pta)	t
<i>Live weight</i>	Increase 1 kg	-7.901	-8.718 ^a
<i>Live fat content 1</i>	Classified in	-77.287	-1.832 ^c
<i>Live fat content 2</i>	Classified in	+13.469	1.399
<i>Live fat content 4</i>	Classified in	-26.509	-4.497 ^a
<i>Live fat content 5</i>	Classified in	-44.894	-3.088 ^a
<i>Sex</i>	Male	+16.390	2.569 ^b
<i>Race</i>	Industrial crossing	-13.435	-1.602 ^b
<i>Experiment n°3</i>	Observed in	-283.85	-37.57 ^a
<i>Experiment n°4</i>	Observed in	-288.15	-33.89 ^a
<i>Experiment n°5</i>	Observed in	-277.53	-27.92 ^a
<i>Experiment n°6</i>	Observed in	-259.33	-30.06 ^a
Constant		1163.2	58.02
Average price (pta)	749.76	F	182.584
No Observations	499	Condition index	26.79
Adjusted R ²	0.8226	Durbin Watson	1.972

^aSignificant at 1percent; ^bSignificant at 5 percent; ^cSignificant at 10 percent; 166.4 Pesetas = 1 Euro

suggesting the existence of user segments with different preference patterns. A segment analysis based on these preference patterns would be very useful to identify and describe groups of operators with similar preferences. Although the present study does not cover this type of analysis, it could be an important tool for lamb producers interested in gathering information on market segments.

The third approach is based on a survey question that gathers information about the importance of twelve qualitative attributes in establishing the commercial value of light lamb carcass³. The three more important

attributes are carcass freshness, meat color and meat smell. These characteristics are commercially important because the product is highly perishable. The renal fat amount and carcass weight appear ranked as fourth and fifth in importance.

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The hedonic technique has been used to determine the importance of the live animal characteristics in explaining prices. The data were

³These twelve attributes are carcass weight, conformation, cover fat, fat color, fat consistency, freshness, geographical origin, meat color, meat smell, pelvic-renal fat, race, sex and thoracic fat.

Table VI. Hedonic price model for the modified sheep carcass classification (8 to 13 kg) of Delfa et al. (1992). (Modelo de precios hedónicos para la clasificación modificada de canales ovinas (8 a 13 kg) de Delfa et al. (1992)).

Variables	Change	Effect on price (Pta)	t
Category - A ₁	Classified in	24.81	1.294
Category - B ₁	Classified in	-13.74	-0.443
Category - C ₁	Classified in	-217.43	-5.127 ^a
Category - A ₂	Classified in	-24.36	-1.401
Category - C ₂	Classified in	-99.15	-1.794
Experiment n ^o 4	Observed in	-11.22	-0.720
Experiment n ^o 6	Observed in	74.46	5.043 ^a
Irregular clients	Type client	36.56	1.879
Regular clients of high volume	Type client	51.95	3.523 ^a
Constant		751.295	26.367
Average price (pta)	733.70	F	13.694
No Observations	100	Condition index	7.30
Adjusted R ²	0.5357	Durbin Watson	2.17

^aSignificant at 1 percent; 166.4 Pesetas = 1 Euro

collected from 600 light lambs, and focus on the attributes commonly used by producers: live weight, live fat content, race or crossing, and sex.

The estimated hedonic price model for live lamb characteristics is presented in **table V**. Besides the qualitative characteristics, the specification includes temporal factors which determine the market situation (Experiment 3, 4, 5, 6). As in carcass, the *fat content* of the live animal is the most important characteristic explaining the value of the animal. The results show that lean lambs depreciate by -78 pta/kg and very fat lambs depreciate by -45 pta/kg. The animals with intermediate fat content reach higher prices in the

market. The second factor in importance is *live weight*. The behavior of *live weight* is similar to *carcass weight*, with a marginal implicit price equal to -7.9 pta/kg. The variable *sex* is important with a 2.2 percent value increase for male animals, although this variable is related to *live weight* and may incorporate some of the effects of *live weight* on prices. When the *race* is industrial crossing, the animal has a slight penalization.

COMMERCIAL ADAPTATION OF CARCASS CLASSIFICATION

The information collected about the opinion of butchers on commercial classification systems indicates that

they support the establishment and operation of carcass and meat classification systems.

The adaptation of two systems of carcass classification has been examined using the data collected, applying the hedonic technique to the categories of both classification systems. These categories are combinations of characteristics. This procedure is an empirical test about the commercial adaptation of classification systems. The two classification systems analyzed are the EU classification system for sheep carcasses weighting less than 13 kg (Council Directive 92/2137/EEC modified by Council Directive 94/1278/EC), and the carcass classification system defined by Delfa *et al.* (1992) for sheep carcasses weighting between 8 and 13 kg⁴.

The hedonic equations have been estimated for the commercial categories of both classification systems, and the results don't show significant differences. Considering the results of this study about fat content evaluation, a slight change has been introduced in the Delfa *et al.* classification system, resulting in a better adaptation of their classification system to the market (**table VI**). The estimated equation using the Delfa *et al.* modified proposal yielded a superior fit ($R^2 = 0.54$) with respect to the EU classification system ($R^2 = 0.44$), which indicates a better adaptation of this classification system to the commercial data obtained experimentally in this study.

⁴Details on the classification system by Delfa are also presented in Cunhal-Sendim (1996).

CONCLUSIONS AND IMPLICATIONS

The results from the different analyses performed in the study show the importance of quality management in the sheep sector. The knowledge about quality perception of light lamb, facilitates the management of quality in order to: i) adjust production to the different demand segments; ii) influence and manipulate the perception of the product quality by the user or consumer; and iii) achieve more efficient commercial relationships among operators.

The management of quality to adapt and adjust the product to market requirements should focus on *fat content*, *carcass weight*, and *meat color* because these are the main attributes in the evaluation of utility by users. The commercial classification systems can be used to improve the efficiency in commercial transactions both in the live sheep and carcass markets, provided that they are based on the real preferences of market agents. These systems may perform the following tasks: i) act as information channels between different agents and links; ii) facilitate the allocation of profits and losses from commercial activities; and iii) assist in the management of quality focused on the market, through product differentiation directed to the various user and consumer segments in order to increase profitability.

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