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REGULAR ARTICLES

Marketing of meat sheep with intensive finishing in southern state of Mexico

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Abstract The objective of the present study was to quantify the marketing margins of cold sheep carcass and *barbacoa* meat in the southern state of Mexico. Data were obtained from the production chain links (production, industrialization, and marketing) where the marketing margins were calculated along with the benefit/cost (B/C) ratio. In the absolute marketing margin of the final consumer price per kilogram of carcass meat, the producer obtained US\$2.7/kg (47 %) of the utilities, while the intermediaries obtained US\$3.1/kg (53 %). Considering the final cooked product in *barbacoa* (typical dish), the margin was US\$6.3/kg (29 %) for the producer and US\$15.2/kg (71 %) for the intermediaries. The B/C ratio was 1.0, 1.1, 2, and 1.3 for the producer, stocker, butcher, and *barbacoa* seller, respectively. It is concluded that the best marketing channel for the producer was the producer-stocker-processor (butcher and *barbacoa* seller). The highest marketing margin was for the intermediaries followed by the producer. The order of importance of the B/C kilogram ratio of meat was for the butcher first, then *barbacoa* seller, and lastly stocker and producer.

Keywords *Barbacoa* · Hair sheep · Marketing channels and margins · Meat · Production costs

Introduction

Sheep production in Mexico has been considered as a productive activity because of the availability of native grasses and forages. However, there is a serious challenge in the integration of the production chain, processing, and marketing of the sheep value. Currently, the demands of the market are unknown due to lack of price information and the characteristics or quality of the products (i.e., breed, sex, age, weight, type of food) (Teferra et al. 2011). These are some of the problems that have halted the development of the production, industrialization, and marketing of sheep meat, skins, and wool in Mexico.

Diverse studies have characterized the productive process and marketing channels of sheep meat in Mexico, as well as the appropriation of the marketing margins on the part of the hair sheep meat producers (Mondragón-Ancelmo et al. 2012; Hernández-Martínez et al. 2013). However, little has been documented with respect to the appropriation of the marketing margin in hair sheep under intensive finishing conditions. It is possible that due to the present price of hair skin (US\$6.5) vs. wool skin (US\$2.7) and the high costs of the cereal grains used in feedlots, changes could be made for the marketing margins.

The objective of the current study was to quantify the marketing margins of hair sheep meat under intensive finishing conditions, in order to increase the capacity of each sector of appropriating the final value, so that in the future, production and marketing strategies for the product can be found.

Materials and methods

The work was carried out in 2013 in the productive sector of the southern state of Mexico and in the industrialization and

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marketing links of the municipality of Capulhuac, state of Mexico. Using the data of primary sources and interviews with informants of the different sectors, the principal marketing channels were identified (Cochran 1984).

Ten farmers dedicated to the production of Katahdin hair sheep were enrolled in the study. Monitoring was carried out during the process of production, industrialization, and marketing productive management: sale of live sheep from the farm, transport to the in situ slaughter, transformation or industrialization to meat and by-products, sale of carcasses and raw by-products to the *barbacoa* sellers or consumer (*barbacoa*, traditional dish in Mexico, where the sheep meat and viscera with diverse ingredients and water are placed in a clay or metal recipient and covered with maguey leaves placed in a hole in the ground, previously heated to red hot, for cooking and seasoning), transformation of carcass and by-products to *barbacoa*, and sale of the *barbacoa* to the final consumer. The following made it possible to obtain indicators of the productive behavior: waste in transport, weight and commercial yield of carcass and raw by-products, weight and yield of carcass and by-products cooked in *barbacoa*, weight and yield of the *barbacoa* meat to tacos, production costs of the live and processed sheep meat, and sale prices of the products and by-products. With the above information, calculations were done to determine costs, prices, and marketing margins of the hair sheep meat.

Productive response indicators

To a sample of 100 sheep of a mean initial weight of 37.7 ± 3.16 kg of the Katahdin breed, DM/day was measured, along with gain of LW/day, and final LW; feed conversion was estimated (CDM/GLW), and production cost was determined to produce 1 kg of live meat, cold carcass, and cooked meat (Table 1).

Value of waste per transport

The difference was calculated of final mean live weight 45.77 ± 3.53 kg, of 100 sheep with live farm sale, minus the weight at arrival to in situ slaughter. The distance of transport was 110 km (approx. 3 h) from the southern portion of the state to Capulhuac (Table 2).

Coefficient of market yield of cold carcass meat

This value was determined with the weight of cold carcass/slaughter weight $\times 100$. The rest of the components of the fifth quarter of the sheep were weighed, red viscera, green viscera; later, yield was calculated (weight of the component $\times 100$ /LW at slaughter) (Table 2).

Yield coefficient of cold carcass meat and raw viscera (*pancita*), to cook meat and *pancita* in *barbacoa* (*pancita*,

Table 1 Productive behavior

Productive response	Unit of measure	Value	SD
Initial live fattening weight	kg	37.4	3.2
Fattening period	day	30	–
Daily weight gain	kg/day	0.3	0.1
Total weight gain	kg	8.4	2.2
Final live weight	kg	45.8	3.5
DM consumption	kg/sheep/day	1.5	0.2
Total DM consumption	kg	44.7	–
Feed conversion	kg	5.3	1.2

SD standard deviation

prepared with green and red viscera along with the components of the reproductive apparatus) (Table 3). These data were registered at the end of the cooking process of the meat in *barbacoa* of a sample of 10 (10 %) sheep carcasses at the home of the *barbacoyero* (a person who prepares the sheep meat in *barbacoa*); next, yield was calculated (weight of the *barbacoa* meat $\times 100$ /weight of cold carcass).

Number of tacos per kilogram of meat cooked

In 55 *barbacoa* stands, three tacos with *barbacoa* meat were purchased from each stand (a taco is when the *barbacoa* meat is wrapped with a tortilla made with a corn or wheat tortilla). An Ohaus precision scale with a maximum capacity of 610 g was used for weighing. Next, the number of tacos per

Table 2 Weight of the components of the carcass and fifth quarter

Concept	Unit of measure	Value	SD
Farm sale	kg	45.8	3.5
Slaughter or market	kg	43.3	3.4
Waste at slaughter	kg	2.5	0.1
Warm carcass	kg	22.0	2.2
Cold carcass	kg	21.5	2.2
Waste of hot carcass	kg	0.5	0.2
Market yield of carcass	%	49.8	2.5
Head	kg	2.1	0.2
Feet	kg	1.0	0.1
Sheepskin	kg	3.9	0.5
Blood	kg	1.6	0.2
Testicles	kg	0.8	0.1
Red viscera (lungs, heart, liver)	kg	1.8	0.3
Full green viscera (reticulum, psalterium, rumen, abomasum, small and large intestine)	kg	8.0	1.0
Empty green viscera (without feces)	kg	2.7	0.4
Content of green viscera (feces)	kg	5.2	0.8
Green and red viscera and testicles (<i>pancita</i>)	kg	5.3	1.2

Table 3 Weight of carcass meat and *pancita* in *barbacoa*

Concept	Unit of measure	Value	SD
Carcass with bone in <i>barbacoa</i>	kg	15.8	1.6
Waste of carcass with bone in <i>barbacoa</i>	kg	5.7	0.5
Boneless <i>barbacoa</i> meat	kg/carcass	13.6	1.2
Bones cooked in <i>barbacoa</i>	kg/carcass	2.2	0.4
Viscera in <i>barbacoa</i> (<i>pancita</i>)	kg	2.5	0.5
Waste of viscera in <i>barbacoa</i>	kg	2.8	0.4
Liters of broth	Liters/carcass	15.0	0.7
<i>Barbacoa</i> contained in taco	g	40.0	5.0
<i>Barbacoa</i> in tacos	Tacos/kg	25.0	5.2
<i>Barbacoa</i> in carcass	Tacos/carcass	341.1	–
<i>Pancita</i> in tacos	Tacos/kg	25.0	5.2
<i>Pancita</i> in carcass	Tacos/sheep	62.5	–
Broth contained in the dish	ml	0.50	55.0
Yield in broth	Dishes/carcass	30.0	6.2

kilogram of *barbacoa* meat was calculated. In addition, the amount of broth per dish was calculated with a graduated test tube with a capacity of 500 ml (Table 3).

Prices of carcass meat, costs and sale prices of *barbacoa* meat to the consumer

These data were obtained from the butchers and *barbacoyer*os. Also, the estimated production costs to produce 1 kg of meat under intensive finishing conditions; the cost of feeding and deworming were considered to produce 1 kg of live meat. Later, 15 % per kilogram of the meat produced was added from other fixed variables and costs (Lara 2008) (Table 4).

Comparison of prices in each marketing level

This information was calculated from data of prices and coefficients of yield of uncooked and cooked meat (Table 5), which made it possible to obtain the equivalent value to the producer at entrance to in situ slaughter and of raw carcass meat, as well as cooked carcass and *pancita* to the consumer.

Marketing margins

The marketing margins were calculated from the difference between the sale price of the unit of product for each marketing agent and the payment made in the purchase of the amount equivalent to the sold unit. To calculate the absolute gross margins (M) and total relative margins (m), the expression of $M = Pc$ (price to final consumer) – VEP (equivalent value to the sheep producer) and $m = (M/Pc) \times 100$ and was adapted to each step of the marketing process with the different prices. The obtained data were processed through a numerical matrix

Table 4 Production costs and sale price of raw and cooked meat

Concept	Unit of measure	Value
Sheep at start of fattening	US\$/kg	2.2
Sheep for fattening	US\$/sheep	83.4
Feed	US\$/kg	0.4
Cost of feed per fattening period	US\$	17.9
Production cost calculated by producer	US\$/kg of live meat	2.5
Production cost calculated by producer	US\$/sheep	20.6
Price of live slaughter	US\$/kg	2.5
Price of live slaughter	US\$/sheep	109.8
Cost of slaughter	US\$/sheep	4.6
Price of cold carcass to the consumer	US\$/kg	5.7
Price of viscera (raw <i>pancita</i>) to the consumer	US\$/unit	10.0
Price of skin	US\$	6.5
Price for the four feet	US\$	1.9
Price of head	US\$	5.0
Cost of preparation and sale of <i>barbacoa</i>	US\$/kg	10.5
Cost of preparation and sale of <i>barbacoa</i>	US\$/carcass	224.8
Consumer price of <i>barbacoa</i> and <i>pancita</i>	US\$/kg	21.5
Consumer price of taco with <i>barbacoa</i> and <i>pancita</i>	US\$/taco	1.0
Consumer price of broth	US\$/dish	1.0

Exchange rate: \$MX13.0 US\$ (Sistema de Administración Tributaria)

created as database in the program Microsoft Excel, according to the methodology proposed by Caldentey (1979).

Results and discussion

Equivalent and relative value of the uncooked cold carcass (meat and by-products)

To produce 1.0 kg of carcass meat, 2.1 and 2 kg of live farm and live slaughter sheep were used (Table 6). These results were lower compared with the previous studies in wool sheep 2.3 and 2.1 kg (Mondragón-Ancelmo et al. 2012). When processing live sheep at slaughter to meat on the part of the butcher, 1.0 kg of cold carcass meat was obtained as main product and 1.0 kg as by-product (*pancita*, skin, feet, head), contrasted with wool sheep 1.0 kg of carcass meat and 1.1 kg of by-products (Mondragón-Ancelmo et al. 2012).

The value of cold carcass meat to the final consumer was US\$5.7/kg, and of the by-products US\$5.7/kg. Equivalent values were obtained from 2.7, 2.7, and US\$5.7/kg of live farm sheep, live slaughter sheep, and cold carcass meat from the slaughter, respectively. The relative value of the cold carcass was 50.1 %, and of by-products 49.9 %. These results are related with the production period and sale of the product;

Table 5 Price and yield coefficient of raw and cooked meat

Concept	Initials	Unit of measure	Value
Live farm price to the producer	Pp	US\$/kg	2.5
Price at entrance to slaughter	PER	US\$/kg	2.8
Price of carcass from slaughter	PSR	US\$/kg	5.7
Price of carcass cooked	PCC	US\$/kg	21.5
Price of <i>pancita</i> from slaughter	Ps	US\$/unit	10.0
Price of <i>pancita</i> cooked	Psub	US\$/kg	21.5
Weighted price of raw by-products (<i>pancita</i> , head, four feet, and skin)	Ppsub	US\$/unit	5.9
Live price of sheep bought from producer	Po	kg	45.8
Waste from transport of sheep to slaughter	MCT	%	5.5
Weight of live sheep at entrance to slaughter	Pl	kg	43.3
Yield coefficient of carcass from slaughter	CRSR	%	50.9
Waste of carcass from slaughter	MSR	%	2.2
Yield coefficient of carcass cooked	CRB	%	31.5
Yield coefficient of raw by-products from slaughter (<i>pancita</i> , skin, head, feet, bone)	RSR	%	49.1
Yield coefficient of <i>pancita</i> cooked	CRPC	%	5.1
Total yield coefficient of meat and <i>pancita</i> cooked	CRTC	%	36.6

at the end and beginning of the year, the prices of sheep meat increase due to the high demand and low supply, compared with the months of the middle of the year, when the supply is high and the demand of sheep meat is low; therefore, the prices tend to decrease. In addition, the wholesaler’s price speculation can modify these values.

Equivalent and relative value of the cooked carcass meat and *pancita*

To obtain 1.0 kg of cooked meat, 2.7, 2.9, and 1.4 kg of live farm sheep, live slaughter sheep, and cold carcass meat are

required (Table 7), respectively; similar results were reported in wool sheep 2.7, 2.9, and 1.3 kg (Mondragón-Ancelmo et al. 2012). When the cold carcass was processed into *barbacoa*, 0.9 kg of boned *barbacoa* meat was obtained as main product and 0.1 kg of cooked *pancita* contrasted with 0.8 kg of meat with bone and 0.2 kg of *pancita* (Mondragón-Ancelmo et al. 2012). The value of *barbacoa* meat to the final consumer was US\$18.6 (0.9 kg) and of *pancita* US\$3.0 (0.1 kg). The equivalent values of the live farm sheep was US\$6.3/kg, live sheep at slaughter in situ US\$6.5/kg, and of cold carcass meat US\$7.9/kg. The relative value of cold carcass meat to *barbacoa* was 86 %, and of the by-product in *barbacoa* was 14 %. These

Table 6 Equivalent and relative value of raw carcass meat

Concept	Initials	Unit of measure	Value
Live sheep at entrance to slaughter in situ required to obtain 1 kg of carcass meat= $1/CRSR \times 100$	QCER	kg	2.0
Live farm sheep required to obtain 1 kg of carcass meat = $(QCER/1-MCT) \times 100$	QCPR	kg	2.1
Participation of the value of the meat			
Main product = $(QCER \times CRSR)/100$	K	kg	1.0
By-products = $(QCER \times RSR9)/100$	Ksub	kg	1.0
Value of the meat			
Carcass meat (main product) = $K \times PSR$	VKpp	US\$	5.7
Value of the by-product			
By-products = $Ksub \times Ps$	Vksub	US\$	5.8
Relative value			
$(VKpp/(VKpp + Vksub)) \times 100$	VR	%	50.1
Equivalent value			
To the producer = $(QCPR) (Pp) (VRC)/100$	VEP	US\$/kg	2.7
To slaughter in situ = $(QCER) (PER) (VRC)/100$	VEER	US\$/kg	2.7
At exit from slaughter in situ = $(QCSR) (PSR)$	VESR	US\$/kg	5.7

Table 7 Equivalent and relative value of the cooked meat

Concept	Initials	Unit of measure	Value
Live sheep at entrance to in situ slaughter needed to obtain 1 kg in <i>barbacoa</i> = $K/CRTC \times 100$	QCER	kg	2.7
Live farm sheep needed to obtain 1 kg in <i>barbacoa</i> = $(QCER/1-MCT)/100$	QCPR	kg	2.9
Cold carcass meat needed to obtain 1 kg of meat in <i>barbacoa</i> = $(QCER)(CRSR)/100$	QCSR	kg	1.4
Participation of the value of the meat in <i>barbacoa</i>			
Main product = $(QCER \times CRB)/100$	K	kg	0.9
<i>Pancita</i> in <i>barbacoa</i> = $(QCER \times CRPC)/100$	Ksub	kg	0.1
Amount of main product = $(QCER \times CRB)/100$	Kpp	kg	0.9
Value of the meat			
Main product (carcass in <i>barbacoa</i>) = $(PCC \times Kpp)$	VKpp	US\$	18.6
<i>Pancita</i> = $(Ksub \times Psub)$	Vksub	US\$	3.0
Relative value			
$(VKpp/(VKpp + Vksub)) \times 100$	VR	%	86.1
Equivalent values			
To the producer = $(QCPR)(Pp)(VRC)/100$	VEP	US\$/kg	6.3
At entrance to slaughter in situ = $(QCER)(PER)(VRC)/100$	VEER	US\$/kg	6.5
At exit from slaughter in situ = $(QCSR)(PSR)$	VESR	US\$/kg	8.0

values can be maintained or increase in time due to the costs of the inputs for the elaboration and marketing of the *barbacoa*.

Marketing margins of uncooked and cooked meat

The absolute marketing margin of cold carcass meat and cooked meat was 3.1 and US\$15.2/kg (Table 8). In relative terms, the producer received 47 and 29 %, the intermediaries 53 and 71 % of the price paid by the final consumer per kilogram of cold carcass meat and cooked meat. Previous studies in wool sheep report 40 %, in cold carcass meat 60 %, and in cooked meat 26 and 74 % (Hernández-Martínez et al. 2013); in goats 47 %, in cold carcass 53 %, and in cooked meat 20 and 80 % (Rebollar-Rebollar et al. 2007) for producers and intermediaries.

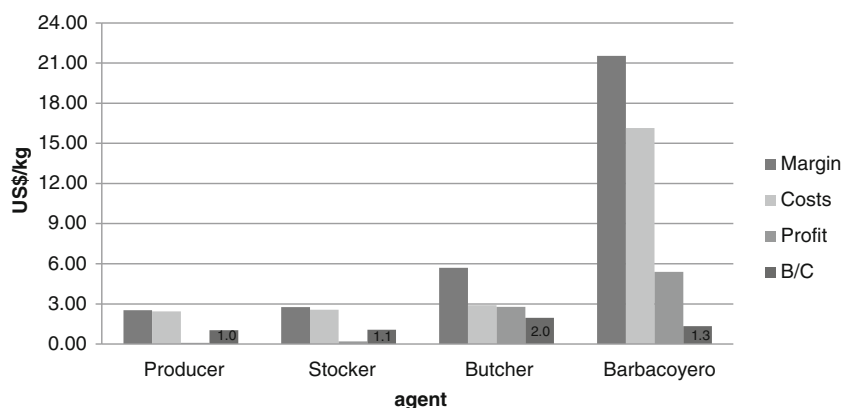
The low marketing margin received by the producer in the current study was due to the fact that the producer had no knowledge of the demand of the market of the stockers and *barbacoa* sellers. In respect to which characteristics of sheep meat quality are required, under what conditions they should be produced, when is the adequate time to produce and sell the product and what quantity to produce to satisfy the demand, and which agent the product should be sold to in order to receive greater margin. This lack of knowledge, along with the price speculation on the part of the intermediaries, limits the producer from receiving a greater marketing margin of the product (Rodríguez et al. 1993). Most of the services could be improved in benefit of the consumers and the producers, if the producer knew the expectations of quality according to the demands of the market, and it would also make it possible to reduce the costs of production and marketing.

Studies carried out in other countries, such as Pakistan, indicated that the participation of the marketing services of

Table 8 Marketing margins of uncooked and cooked meat

Concept	Uncooked		Cooked	
	Absolute, US\$/kg	Relative, %	Absolute, US\$/kg	Relative, %
1. Equivalent value to the producer	2.7	46.5	6.3	29.3
2. Equivalent value to the stocker	2.7	47.9	6.5	30.2
3. Equivalent value to the butcher	5.7	100.0	7.9	36.7
4. Gross margin of stocking of sheep (2–1)	0.1	1.4	0.2	0.9
5. Gross margin of transformation of sheep (3–2)	3.0	52.1	1.4	6.5
6. Gross margin of marketing (7–1)	3.1	53.5	15.2	70.7
7. Price paid by the final consumer	5.7	100.0	21.54	100.0

Fig. 1 Benefit/cost ratio of the marketing margins for each agent



sheep and goats represents 32 and 30 % for the intermediaries and the rest for the producer (Mahmood and Rodríguez 1993). Abbott (1987) reported similar results in sheep meat, 64 and 36 %; in beef, 66 and 34 %; and in pork, 75 and 25 % for producers and intermediaries, respectively. These results are attributed to the fact that the productive chains of sheep, beef, and pork had an organization for the marketing of the final product.

Costs, profit, and benefit/cost ratio of uncooked and cooked meat

The income received by each agent for the sale of 1 kg of sheep meat was as follows: producer (US\$2.5 for the sale of a kilogram live farm sheep), stocker (US\$2.8 for the sale of a sheep at slaughter), butcher (US\$5.7 for the sale of a kilogram cold carcass meat), and *barbacoya* seller (US\$21.5 in the sale of *barbacoya*). Of these incomes, production cost and profit for the producer was US\$2.5/kg (96 %) and US\$9.0/kg (4 %), stocker US\$2.6/kg (93 %) and US\$0.2 (7 %), butcher US\$2.9/kg (51 %) and US\$2.8 (49 %), and for the *barbacoya* seller US\$16.1/kg (75 %) and US\$5.4/kg (25 %). The butcher obtained the best B/C ratio, followed by the *barbacoya* seller, stocker, and producer finally (Fig. 1).

The B/C kilogram ratio of meat obtained by the butcher was due to the fact that not only did he sell the carcass meat, but also *pancitas*, head, feet, and skin, and his production costs were low compared with those of the *barbacoya* seller and the producer. The low B/C ratio to the producer is attributed to the high cost of the cereals that were used in the animal feeding, which contributed to the increase of production costs of 1 kg of live meat (Lupton et al. 2007), added to price speculation on the part of the intermediaries (Mondragón-Ancelmo et al. 2012). Therefore, it is necessary to find other alternatives of production that minimize the cost of feed (Braga et al. 2011), to produce more than 60 % of the inputs (Martínez-González et al. 2011), and shorten the marketing channels that induce a higher B/C for the producer, and allow an increased profitability of sheep production systems.

Conclusions and recommendations

The best marketing channels used by the producer were producer-stocker-processors (butcher and *barbacoya* seller). The best marketing margin was for the intermediaries followed by the producer. The highest B/C kilogram ratio of meat was for the butcher, *barbacoya* seller, stocker, and producer. It is recommended that the producer markets his/her product directly to the processors (butcher and *barbacoya* seller). Additionally, if the producer has the economic resources, along with having, or acquiring knowledge, he/she can perform the processing of his/her own product, such as in primary and secondary cuts for direct sale to restaurants or to the final consumer. However, for this purpose, a detailed and in depth market study is required to document the tastes and preferences of final consumers in the region of influence of sheep meat.

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Conflict of interest All authors declare that there are no present or potential conflicts of interest among the authors and other people or organizations that could inappropriately bias their work.

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