MARGINS OF SHEEP MEAT MARKETING IN CAPULHUAC, STATE OF MEXICO

[MARGENES DE COMERCIALIZACIÓN DE LA CARNE DE OVINO EN CAPULHUAC, ESTADO DE MÉXICO]

J. Mondragón-Ancelmo[1], I. A. Domínguez-Vara[1*], S. Rebollar-Rebollar[2], J. L Bórquez-Gastélum[1], J. Hernández-Martínez[2]

[1]*Departamento de Nutrición Animal. Facultad de Medicina Veterinaria y Zootecnia. Universidad Autónoma del Estado de México (UAEMéx.).Campus Universitario "El Cerrillo" Toluca, México. C.P. 50090.*
[2]*Centro Universitario UAEM Temascaltepec. Universidad Autónoma del Estado de México (UAEMéx.).*
* Tel. y Fax: 01 (722) 2 96 55 49. Email: igy92@hotmail.com
*Corresponding Author

SUMMARY

The objective of this investigation was to identify the channels and analyze the incorporation of the marketing margins of different participants in the productive chain of sheep meat in the municipality of Capulhuac, State of Mexico, during the period 2009-2010. The marketing channel most widely used by the participants of this market was identified, and absolute and relative profit margins were calculated through their equivalent values of the costs and profits of each participating actor. Of the 31 sheep farms or producers interviewed, 58.3 % carried out the sale of live sheep at farm. Considering the absolute margin of marketing in the final price to the consumer per kg of raw meat, the producer obtained 2 USD/kg (40 %) and the intermediaries 3 USD/kg (60 %). Profit in selling cooked final product (barbacoa typical dish), was obtained 4.5 USD/kg (25.7 %) for the producers and 13 USD/kg (74.3 %) for intermediaries. Evidence was found that the most common marketing channel was producer, intermediary, barbacoa seller and final consumer, in which the barbacoa seller obtained the highest benefit-cost ratio.

Key words: sheep; farms; marketing; margins; meat; barbacoa; producer.

RESUMEN

El objetivo de esta investigación fue identificar los canales y analizar la apropiación de los márgenes de comercialización, por los distintos actores, en la cadena productiva de la carne de ovino en el municipio de Capulhuac, Estado de México, durante el periodo 2009-2010. Se identificó el canal de comercialización más usado por los actores participantes de dicho mercado; se calcularon los márgenes absolutos y relativos a través de la obtención de sus valores equivalentes, de los costos y ganancias de cada actor participante. De los 31 productores entrevistados, 58.3 % realiza la venta en pie. Respecto el margen de comercialización del precio final al consumidor por kg de carne sin cocción, el productor obtuvo 27.3 $/kg (40 %) y los intermediarios 38.7 $/kg (60 %). Considerando el producto final con cocción (barbacoa), 59.3 $/kg (25.7 %) para el productor y 169.7 $/kg (74.1 %) para los intermediarios. Se observó por las evidencias encontradas que el canal de comercialización más común fue de productor, acopiador, barbacoyero y consumidor final, en el que el barbacoyero obtuvo los mayores índices de beneficio-costo.

Palabras clave: Ovinos; unidades de producción; comercialización; márgenes; barbacoa; productor.

INTRODUCTION

In Mexico, sheep farming faces various problems that limit the development of sheep meat production, including technological lag, undervalued activity, practiced on small farms and traditional consumption (barbacoa) (Trejo, 2008). Investigation in Mexico is still isolated or is removed from the real production needs (Samaniego, 2000; Tomillo, 2001; FAO, 2010). This has been characterized by generating technologies for those producers that have the economic resources necessary for their application, without attending the producers with low economic incomes (Tomillo, 2001; Góngora *et al.*, 2010). Furthermore, the different actors of the sheep production chain (sheep farms or producers, marketers, processors, barbacoa sellers and consumers), as well as the investigators, technicians and governmental sectors, have not recognized the need for integration to achieve strategies that

contribute to the improvement of sheep meat production (Samaniego, 2000; Montossi, 2002; FAO, 2010). Other countries have taken advantage of this opportunity to introduce sheep meat to the national market, due to the demand that exists of this meat; for example, meat imported from New Zealand, Australia, Canada, Chile and the United States is used to elaborate barbacoa.

In Mexico sheep carcass production increased 54 % (2.8 % annually), from 24, 695 to 53, 737 t (1990-2009); in 2009 the participation of this kind of meat was 0.9 % of the total meat production of farm animals (153.8 million t), which has not undergone significant changes since 1980 to 2009 with respect to other meats (Figure 1). The principal production entities were: the State of Mexico, Hidalgo, Veracruz, Puebla, Jalisco and Zacatecas with 14.7, 12.8, 9.3, 6.6 and 5.4 % (SIAP, 2010). These entities contributed with slightly more than half (55.4 %) of the national production, the rest (44.6 %) was covered by other entities.

The per capita consumption of sheep meat in Mexico from 2008-2009 increased from a range of 0.5-0.8 to 1 kg (SIAP, 2010). In 2008 the national apparent consumption (NAC) registered 90,000 t of meat, and the participation of imports in total consumption was approximately 45 %. The price of national sheep meat carcass was attractive (USD 4.2/kg), which was above the price of imported meat (USD 2.7/kg) (Trejo, 2008). Suárez and Sagarnaga (2000) mentioned that per capita availability of sheep meat was very low compared with meat from other farm species, indicating that consumption of this kind of meat by Mexicans is low due to high cost of the product (barbacoa). Three important aspects are considered to affect this low consumption such as a reduction in the growth rate of human population (0.9 %) in the period 2005-2009 (INEGI, 2009), reduction in importation of sheep meat (6.8 %) from 2004-2007, as well as an increase of sheep meat production (9.5 %). Although, production has not been high enough to satisfy the national demand, which represents an opportunity of production and marketing for sheep producers.

In Mexico in 2009, the State of Mexico occupied first place as producer of sheep meat carcass. In this entity, the sheep were distributed among the eight Rural Development District (RDD): Atlacomulco, Toluca, Texcoco, Zumpango, Valle del Bravo, Jilotepec, Coatepec Harinas and Tejupilco, which participated with 28.6, 25.5, 12.9, 12.0, 7.3, 7.3, 5.6 and 0.9 % of sheep meat carcass. Furthermore, in 2009 five of the 24 municipalities of the RDD of Toluca supplied 62 % of sheep meat, outstanding Temoaya, Zinacantepec, Almoloya de Juárez, Chapultepec and Otzolotepec (SIAP, 2010).

Due to its great importance in supplying and marketing sheep meat, the municipality of Capulhuac of the State of Mexico participated with only 2 % of the sheep meat production in the RDD of Toluca in 2009. However, this municipality is of great importance in the marketing of barbacoa meat, to the extent that it occupies first place in barbacoa production and as sheep stocking center in Mexico (Aguilar, 2007). Furthermore, it is outstanding in the importation of frozen meat from Australia, New Zealand and U.S.A. This is because the high demand of barbacoa in the central states of Mexico and Federal District. Presently, the routes or commercialization channels and the appropriation of the margins of sheep meat marketing in this municipality and in the region are not documented.

The channels of distribution or marketing are the routes followed by a product to reach the final consumer (agents or actors involved in obtaining the product and taking it to the consumer or meat transformers) (Caldentey, 1979; Bustamante, 2001). The agents may be whole sellers or retailers and can have influence on the management of the product. The marketing margin is the remuneration established and received by each one of the marketing agents (intermediary, transformer, stocker and distributer). This is represented by the retributions derived from the investments they make, the costs they incur in, plus a profit for each one of them to carry out the marketing; it is determined by the differences between the prices to the consumer, retailer, whole seller and producer. By measuring the differences among prices, the percentages of these differences are estimated (NAFIN, 1998).

The marketing margin can be divided into its components; a) price of the primary product (price to the producer), and b) price of marketing from the farm to the final consumer. The part that covers commercialization is also known as marketing margin, which is the difference between what the consumer pays and what is received by the farm producer (Wohlken, 1991). The marketing margin includes all of the expenses made to add value to the product, such as storage, conditioning, transportation and offering it to the consumer; it also includes the profits of the agents of transformation, storage, distribution and marketing (Schwentesius and Gómez, 2004). The objective of this investigation was to identify the channels and to analyze the appropriation of the marketing margins by the different actors in the sheep meat production chain in the municipality of Capulhuac, State of Mexico, during the period 2009-2010, so that it may be used as a base in identification of opportunities of chain integration, evaluation of sheep production system, and opportunity to develop sheep husbandry in the region.
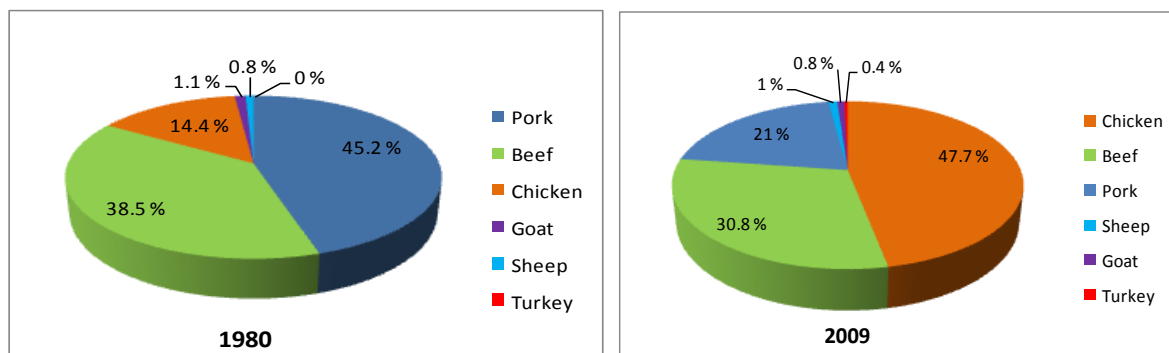
Figure 1. Meat production of the principal farm species in Mexico in 1980 and 2009 years.

MATERIALS AND METHODS

The field work was carried out from 2009-2010 in the municipality of Capulhuac, State of Mexico. The information was obtained by observational investigation method, proposed by Lovelock *et al.* (2004) and application of questionnaires through personal interviews (Cochran, 1984). Were carried out 31 interviews to sheep farms, 35 to barbacoa sellers and two to introducers; the interviews to introducers were reduced, due to the mistrust of these actors.

The coefficient yield of meat carcass was obtained from a sample of 64 male sheep, with a live weight of 46.4±3.8 kg. The coefficient yield of cooked carcass meat (barbacoa) and cooked viscera byproducts (pancita), was directly obtained from the slaughter of the animals *in situ* (at home of barbacoa producer). Sheep losses during transport from production unit to *in situ* slaughter was obtained from 64 animals; body weight losses to the sale points in the region, was found to be 3.8 kg (8 %) during transport.

The prices of carcass meat were obtained from 35 barbacoa producers who slaughtered animals *in situ*. The prices of direct sale to the consumer of barbacoa and pancita per kilogram and in the form of tacos were obtained from direct interview to these same barbacoa sellers. The parity of Mexican pesos to American dollars prices was consulted in http://www.sat.gob.mx.To calculate the number of tacos per kilogram of barbacoa and pancita, an Ohaus precision scale was used with maximum capacity of 610 g. Twenty six barbacoa sellers were interviewed, located in the municipality of Capulhuac, State of Mexico where two tacos were bought and weighed in each stand. The amount of consommé per plate was also measured with a graduated test tube with a capacity of 500 ml.

The prices used to calculate the marketing margins were as follows: prices of live sheep in the production unit, prices at slaughter and at municipal plaza for live animals sale, carcass price at slaughter, price of viscera byproducts (pancita) and prices to the final

consumer of cooked meat as barbacoa (Tables 1 and 2).

The comparison of prices in each marketing level was obtained by calculating the equivalent value to the producer at arriving to slaughter (*in situ*) and of meat carcass, as well as the barbacoa and pancita to the consumer. The marketing margins were calculated from the difference between the sale price of one unit of product by each marketing agent and the payment made in the purchase of the equivalent amount to the unit sold (Caldentey, 2007; García *et al.,* 1990). To calculate the gross absolute margins (M) and total relative margins (m), the formula used was $M = Pc-VEP$, and $m = (M/Pc)*100$ and was adjusted to each stage of the marketing process with different prices (Table 3). The data were processed by means of a numerical matrix created as data base in the program Microsoft Excel, according to the methodology proposed by Caldentey (1979), and Rebollar *et al.* (2007).

RESULTS AND DISCUSSION

The prevalent feeding system in sheep production in the municipality of Capulhuac was grazing (87.1 %); the flocks graze on native vegetation and crop residues in the region, with lack of technical management. In 9.7 % of the production units, the feed is mixed (grazing and feed supplement); the sheep graze on native vegetation and crop residues of the region, however, sheep can graze on improved forage such as white clover (*Trifolium repens* associated with rye grass (*Lolium perenne*), and at night they are complemented with concentrate. Better management can be applied to sheep according their physiological stage; 3.2 % of the production units keep their sheep in total confinement and feed them concentrate and ground corn stover; in addition, they carry out zootechnical control according to the productive phase. In the latter two systems, hair breeds (Dorper, Kathadin and Blackbelly) and wool breeds (Hampshire and Suffolk) are bred to obtain sheep for breeding and for meat production, mainly for barbacoa production.

Table 1. Mean values for calculating marketing margins of raw and cooked (barbacoa) sheep meat.

Concept	Measuring unit	Value
Initial body weight lamb (IBWL)	kg	26.2±3.4
Cost of lamb at the start of feeding (CLSF)	USD/kg	1.9±0.1
Cost of lamb during feeding (CLDF) = IBWL * CLSF	USD/sheep	50
Feeding period (FP)	days	64
Daily weight gain (DWG)	kg/day	0.32±0.04
Total weight gain (TWG) = (FP * DWG)	Total kg	20.2
As fed feed intake (AFFI)	kg/sheep/day	1.69±0.2
Total as fed feed intake (TAFFI) = FP * AFFI	kg/period	108.2
Feed cost (FC)	USD/kg	0.3
Total feed cost (TFC) = TAFFI * FC	USD/period	28.9
Amount of meat used in the calculations (K)	kg	1
Final body weight lamb sale at farm (FBWL) = IBWL + TWG	kg	46.4±3.8
Live weight at slaughter or market sale (LWS)	kg	42.6±3.4
Loss of final live weight at slaughter or market (LFLW) = FBWL - LWS	kg	3.9
Yield at *in situ* slaughter (YISS)= LWS *100/ FBWL	%	91.6
Feed conversion (FC)= AFFI / DWG	kg	5.3
Production cost calculated by the producer (PCCP)	USD/kg meat	1.7
Production cost calculated by the producer (PCCP1)	USD/sheep	34.3±4.7
Live sale price at municipal plaza (LKSPP)	USD/kg	2.1±0.1
Live sale price at municipal plaza (LSSPP)= LKSPP * LWS	USD/sheep	90.9
Live price at *in situ* slaughter (LPS)	USD/kg	2.1
Live price at *in situ* slaughter (LPS)= LKSPP * LWS	USD/sheep	90.9
Kilograms carcass price (KCP)	USD/kg	5±0.2
Price of raw meat to consumer (PRMC)	USD/kg	5±0.2
Price of non fried or raw viscera (PRV)	USD/kg	5±0.2
Sheep *in situ* slaughter (SCISS)	USD/sheep	3.8
Price of barbacoa meat (PBM)	USD/kg	17.5±0.8
Price of pancita (PP)	USD/kg	17.5±0.8
Price of barbacoa or pancita taco (PBPT)	USD/taco	0.9±0.04
Price of consommé (PC)	USD/plate	0.9±0.04
Price of sheep leather (PSL)	USD/sheep	2.7

The most common marketing channels in sheep meat production chain in Capulhuac, State of Mexico, are producer-stocker-barbacoa sellers, and final consumer. A description is made of the marketing channels found in the present investigation; 58.3 % of the producers participate with 89.2 % of the final price when they sell their live animals to a marketing agent (stocker) (Figure 2); this is done only when there is economic urgency or when the lambs have reached the age and live weight for slaughter (45-50 kg); sometimes, the animals are overweight for marketing, and are consequently sanctioned in the price due to the accumulation of fat in the carcass, which causes a reduction in the yield of meat and barbacoa. Sex, live weight and age were the factors of highest relevance in determining the price of purchase by stocker. The stocker finalizes the lambs until they reach 45-50 kg weight, or sells them directly to another marketing and transformation agent (barbacoa seller) with 10.7 % increase with respect to the price received by producer. Carrera (2008); López *et al.* (2008); Nuncio *et al.* (2001); Vázquez *et al.* (2009); and Góngora *et al.* (2010) mentioned that the sheep are sold to small and large intermediaries who later sell the animals to meat processors, which does not differ from what we found in this study.

The 32.3 % of the producers sell their live sheep directly to the barbacoa sellers; only 9.7 % of the producers close the marketing channel, they are producers that also prepare and sell the barbacoa directly to the final consumer; in this way, the participation of the producer is 100 % in the final price. In this marketing channel there is certain investment mainly by enterprising producers. One of the most important characteristic of this marketing channel is that the principal actor is open to adopt new technologies, technical advice in raising and feeding sheep, and possesses knowledge in preparing and marketing barbacoa (Figure 2).

The above information was used to calculate the relative and equivalent values of uncooked (Table 4) and cooked carcass meat (Table 5).

Table 2. Additional mean values for calculating marketing margins of raw and cooked (barbacoa) sheep meat, pancita and consommé.

Concept	Measuring unit	Value
Live kg farm sale (LKFS)	USD/kg	1.9±0.1
Live sheep farm sale (LSFS)= LKFS * FBWL	USD/sheep	88.6
Hot carcass yield (HCY)	kg	20.1±1.9
Cold carcass yield (CCY)	kg	19.4±2
Loss from hot to cold carcass (LHCC)= HCY – CCY	kg	0.7
Yield kg of head (YKH)	kg/sheep	1.9±0.3
Yield % of head (YPH)= YKH *100/ LWS	%/sheep	4.5
Yield kg of feet (YKF)	kg/sheep	1.4±0.2
Yield % of feet (YPF)= YKF *100/ LWS	%/sheep	3.2
Yield kg of sheep leather (YKL)	kg/sheep	6.8±1.4
Yield % of sheep leather (YPL)= YKL *100/ LWS	%/sheep	16
Yield kg of blood (YKB)	kg/sheep	1.5±0.3
Yield % of blood (YPB)= YKB *100/ LWS	%/sheep	3.5
Yield kg of testicles (YKT)	kg/sheep	0.3±0.1
Yield % of testicles (YPT)= YKT *100/ LWS	%/sheep	0.8
Yield kg of red viscera (lungs, heart, liver) (YKRV)	kg/sheep	2.1±0.3
Yield % of red viscera (YPRV)= YKRV *100/ LWS	%/sheep	5.0
Weight kg of full green viscera (stomach, intestines) (WKGV)	kg/sheep	8.4±0.6
Yield kg of green viscera (rumen, reticle, psalterium, abomasum and intestines) (YKGV)	kg/sheep	3.8±0.6
Content kg of intestines (feces) (CKI)= WKGV – YKGV	kg/sheep	4.6
Yield % of intestines (feces) (YPIF)= CKI *100/ LWS	%/sheep	10.7
Yield % of intestines (YPI)= YPIF *100/ LWS	%/sheep	9.0
Total yield kg of green and red viscera and testicles (TKYGRV)= YKRV + YKGV+ YKT	kg	6.3
Total yield % of green and red viscera, and testicles (TYPGRV)= TKYGRV*100/ LWS	%/sheep	14.8
Cost of kg preparation and sale of barbacoa (CKPSB)	USD/kg	2.7±0.1
Cost of sheep preparation and sale of barbacoa (CSPSB)= CKPSB * CCY	USD/sheep	51.6±2.7
Carcass kg yield as barbacoa (CKYB)	kg/sheep	13.0±0.2
Carcass kg loss as barbacoa (CKLB)= HCY-CKYB	kg/sheep	7.1
Carcass % loss as barbacoa (CPLB)= CKLB *100/ HCY	%/sheep	35.4
Average % carcass yield as barbacoa/live animal at slaughter (APCYB/AS)= CKYB *100/ HCY	%/sheep	64.7
Average kg yield of viscera as pancita (AKYVP)	kg/sheep	3.7±0.1
Loss of kg viscera as pancita (LKVP)= TKYGRV- AKYVP	kg/sheep	2.6
Loss % of viscera as pancita (LPVP)= LKVP *100/ TKYGRV	%/sheep	42.0
Yield % of viscera as pancita (YPVP)= AKYVP *100/ TKYGRV	%/sheep	58.1
Amount of consommé per plate (ACPP)	ml/plate	308.0±33.8
Yield of consommé (YC)	Plates/sheep	49.3±6.2
Average yield of consommé (AYC)	Liters/sheep	15.6±0.7
Weight of barbacoa meat per taco (WBPT)	g/taco	42.2±13
Yield of barbacoa meat in tacos (YBT)	Tacos/kg	26.5±10.2
Yield of barbacoa from carcass in tacos (YBCT)=CKYB*YBT	Tacos/sheep	344.5
Yield kg of pancita in tacos (YKPT)	Tacos/kg	26.5±10.2
Yield of sheep pancita in tacos (YSPT)= AKYVP*YKPT	Tacos/sheep	96.7

Most of the barbacoa sellers carryout *in situ* slaughter (at their home), similar to what was reported by Abbott (1987) and FAO (2009), who indicated that after the purchase of the livestock, it is slaughtered *in situ* in urban or rural regions; some researchers have indicated that the slaughter of pigs is also carried out *in situ* by retailers (González *et al.*, 2010). Later, the carcass is air cooled for 24 hours and is then cut without a definite pattern. The most complete as possible pieces are obtained, with a size that permits them to be place in stainless steel pots for cooking. There is no difference with respect the type of cut and the price at which it can be sold in the market; the entire carcass is sold as barbacoa, at the same price. This dish is mainly sold as tacos in stands placed on the street, municipal markets and in restaurants of the State of Mexico and the Federal District.

Table 3. Prices for comparing marketing levels of raw and cooked (barbacoa) sheep meat and pancita.

Concept	Measuring unit	Value
Sheep price at farm price to producer (SPF)	USD/kg	1.9
Sheep price at *in situ* slaughter (SPS)	USD/kg	2.1
Exit price of sheep carcass from *in situ* slaughter (EPSCISS)	USD/kg	5.0
Price of sheep as kg barbacoa (PSKB)	USD/kg	17.5
Price of kg sheep uncooked viscera (PKSUV)	USD/kg	5.0
Price of kg sheep cooked viscera (PKSCV)	USD/kg	17.5
Weight of sheep bought from producer (WSP)	kg/sheep	46.4
Loss transport of sheep at entrance to *in situ* slaughter (LTSISS)	%	8.4
Weight of sheep entering at *in situ* slaughter (WSEISS)	kg	42.6
Yield coefficient of carcass from *in situ* slaughter (YCCISS)	%	47.3
Weight loss of carcass after *in situ* slaughter (WLCISS)	%	3.5
Yield coefficient of cooked carcass (barbacoa) (YCCC)	%	30.6
Yield coefficient of viscera from carcass (YCC)	%	52.7
Yield viscera byproducts (pancita) coefficient (YVC)	%	6.9
Total yield coefficient in transformation process (TYCTP)	%	37.5

Table 4. Relative and equivalent values of uncooked sheep meat in Capulhuac, State of Mexico.

Concept	Measuring unit	Value
Kilograms sheep *in situ* slaughter to obtain one kg of meat to consumer (KSISS)=1/YCCISS*100	kg	2.1
Kilograms sheep at farm to obtain one kg of meat to consumer (KSF)= KSISS/(1-LTSISS)*100	kg	2.3
Participation of meat value in total value		
By Processing KSISS the carcass meat (principal product) is obtained (K)= KSISS*YCCISS/100	kg	1.0
Kilograms of byproduct (viscera to prepare pancita) obtained (KB) = KSISS * YCC/100 I	kg	1.1
Meat value		
Value of carcass meat (principal product) (VCM) = K*EPSCISS	USD	5.0
Byproduct value		
Byproduct value (BV) =KB*PKSUV	USD	5.6
Relative value of uncooking sheep meat (RVUCSM)		
RVUCSM=(VCM/(VCM+BV)*100	%	47.0
Equivalent values		
Equivalent value to the producer (EVP)=(KSF) (KSISS) (RVUCSM)/100	USD/kg	2.0
Equivalent value at entrance to *in situ* slaughter (EVEISS)=(KSISS) (SPS) (RVUCSM)/100	USD/kg	2.1
Equivalent value at exit from *in situ* slaughter (EVEISS)=(KSISS) (YCCISS) (EPSCISS)/100	USD/kg	5.0

Studies carried out in goats (Rebollar *et al.*, 2007) and pigs (González *et al.,* 2010) in the south of the State of Mexico indicated that the marketing channel was producer, regional stocker, retailer and final consumer, which is similar to what was found in this investigation. On the other hand, D'Aubeterre *et al.* (2007) found four sheep meat marketing channels in Venezuela: 1) producer and consumer; 2) producer, butcher shops/supermarket and consumer; 3) producer, stocker, carrier, retailer and consumer; 4) producer, stocker-carrier, slaughterhouse, butcher shop/supermarket, restaurants and consumer. Bravo *et al.* (2002) indicated that the beef meat marketing channel is producer, stocker, introducer, municipal slaughterhouse, meat carcass whole seller, retailer and final consumer. However, when the distance between the points of production and consumption is short, the marketing channel is simple, that is, the butchers buy live animals from the producers at the production unit or at local market, they slaughter and prepare the animals in a local slaughterhouse and sell the meat in a market stand or in a retail establishment (Abbott, 1987). Pittet *et al.* (1994) mentioned that the sheep meat marketing channel in U.S.A. is very long with important degrees of inefficiency and with a tendency to shorten it to improve the profitability of the business.

Table 5. Relative values and equivalents of cooked meat (barbacoa) in Capulhuac, State of Mexico.

| Concept	Measuring Unit	Value
Kilograms sheep at *in situ* slaughter to obtain one kg of meat to the consumer(KSISS)= K/TYCTP *100	kg	2.7
Kilograms sheep at farm needed to obtain one kg of meat to the consumer (KSF)= KSISS/1-LTSISS/100	kg	2.9
Kilograms of carcass meat at exit from *in situ* slaughter needed to obtain one kg of meat to the consumer (KCISS)=(KSISS) (YCCISS)/100	kg	1.3
Participation of the value of the barbacoa meat in total value		
By processing KSISS barbacoa meat (principal product) obtained by K= KSISS*YCCC/100	kg	0.8
Kilograms of byproducts (viscera to prepare pancita) obtained (KB)= (KSISS) (YVC)/100	kg	0.2
Amount of principal product (APP)= (KSISS) (YCCC)/100	kg	0.8
Value of meat		
Value of principal product (VPP) = (PSKB) (APP)	USD	14.3
Value of byproducts (viscera to prepare pancita) (VB) = (KB) (PKSCV)	USD	3.2
Relative value of barbacoa meat (RVB)		
RVB = (VPP/(VPP + VB) * 100	%	82.0
Equivalent values		
1. Equivalent value at entrance to *in situ* slaughter (EVISS) = (KSF) (SPF) (RVB)/100	USD/kg	4.5
2. Equivalent value at entrance to *in situ* slaughter (EVISS) = (KSISS) (SPS) (RVB)/100	USD/kg	4.6
3. Equivalent value at exit from *in situ* slaughter (EVEISS) = (KCISS) (EPSCISS)	USD/kg	6.4
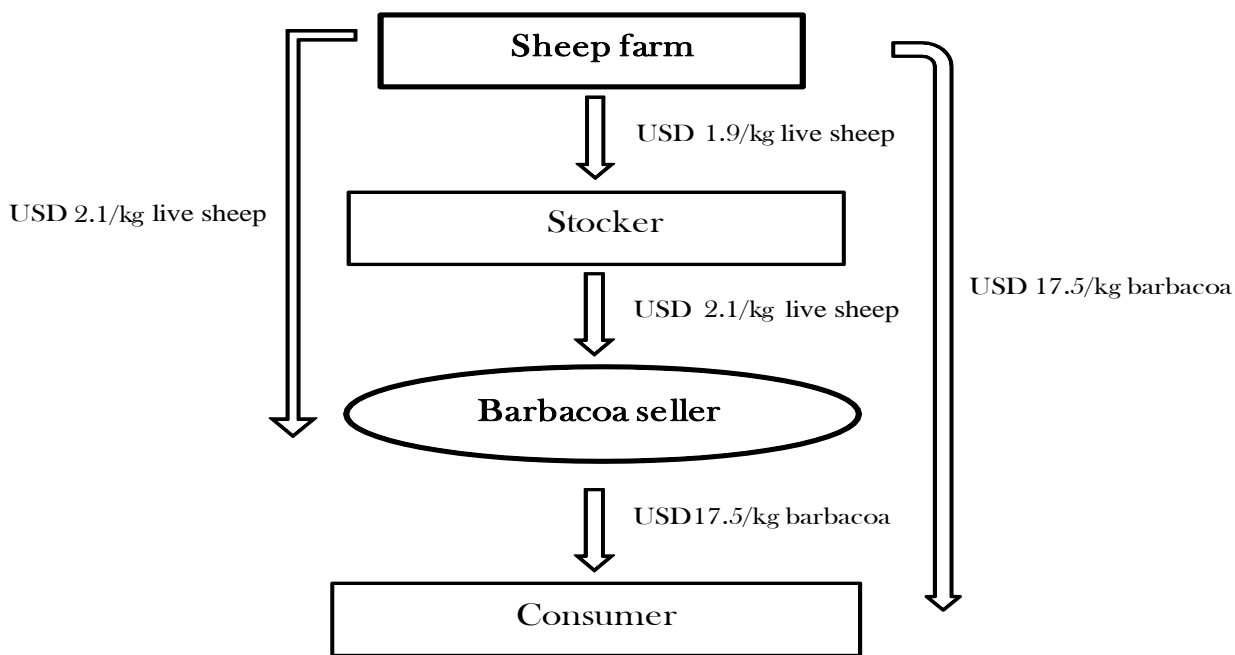
Figure 2. Sheep meat marketing channels in Capulhuac, State of Mexico.

Table 6. Calculation of the net economic profit per live sheep obtained by the farm.

Tipe of sale	Total cost, USD	Total income, USD	Profit, USD[a]	B/C[b]
If the sale is as:				
Live sheep in corral	84.2[1]	88.6[6]	4.4	1.05
Live sheep in plaza	85[2]	90.9[7]	5.9	1.06
Carcass meat	88.8[3]	101.4[8]	12.6	1.14
Barbacoa and pancita	51.6[4]	291.2[9]	239.6	5.64
Tacos (barbacoa, pancita and consome)	51.6[5]	430.6[10]	379	8.34

[1]Cost of production per sheep (feed, health plus 15 % per kg of sheep produced from labor, operation costs, depreciation of installations and equipment, financial costs, light, water, plus the cost of sheep at the start of fattening) (Lara, 2008).
[2]Sale price of live sheep in corral plus the cost of transport to plaza or *in situ* slaughter (0.8 USD/sheep).
[3]Sale price of live sheep in plaza or *in situ* sacrifice plus the cost of *in situ* slaughter.
[4]Cost of preparation, sale of barbacoa, pancita and consommé per sheep.
[5]Cost of preparation of barbacoa, pancita and consome per sheep.
[6]Cost of sheep at start of fattening multiplied by the final live weight farm sale.
[7]Sale price of live sheep in plaza or *in situ* slaughter multiplied by live weight of sheep placed in plaza or *in situ* slaughter.
[8]Carcass yield of sheep multiplied by carcass sale price.
[9]Carcass yield in barbacoa plus yield of pancita multiplied by the sale price for each kg of pancita.
[10]Yield of tacos of barbacoa per sheep plus yield of tacos as pancita/animal plus the yield of consommé per sheep multiplied by the sale price of barbacoa as taco, pancita as taco and consommé per plate.
[a]Profit (total income minus total cost).
[b]Ratio benefit (B)/cost (C) (total income divided by total cost).

Table 7. Calculation of net economic profit per live sheep obtained by the barbacoa seller or stocker.

Tipe of sale	Total cost USD	Total income USD	Profit USD[a]	B/C[b]
If the sale is in:				
Live sheep in plaza	90.9[1]	90.9	0	1
Carcass meat	94.8[2]	101.4[5]	6.6	1.06
Barbacoa and pancita	146.3[3]	291.2[6]	144.9	1.99
Tacos (barbacoa, pancita and consommé)	146.3[4]	430.6[7]	284.3	2.94

[1]Sale price of sheep placed in plaza or *in situ* slaughter multiplied by live weight of sheep placed in market or *in situ* slaughter.
[2]Total price of live sheep at plaza or *in situ* slaughter plus the cost of *in situ* slaughter.
[3]Total price of sheep carcass plus cost of preparation, sale of barbacoa and pancita.
[4]Total price of sheep carcass plus cost of preparation, sale of barbacoa, pancita and consommé.
[5]Yield of sheep carcass multiplied by the carcass price per kg.
[6]Yield of carcass as barbacoa plus the yield of pancita multiplied by the sale price per kg of barbacoa and pancita.
[7]Yield of barbacoa tacos per sheep plus yield of pancita tacos per sheep plus yield of consommé per animal multiplied by the sale price of barbacoa per taco, pancita per taco and consommé per plate.
[a]Profit (total income minus total cost).
[b]Ratio benefit (B)/cost (C) (total income divided by total cost).

When a comparison was made of the net profit obtained by producer at farm and the stocker or barbacoa processor at the plaza (Tables 6 and 7), it was found that the total income of the producer was lower (2.5 %) with respect the stocker or barbecue processor. To this respect, in the study carried out by Rebollar *et al.* (2007), a lower income (19.1 %) was obtained by the goat breeder with respect to the stocker or processor of goat meat as birria (typical dish).

The absolute margin of marketing of the raw and cooked meat (barbacoa) was 3 USD and 13 USD/kg

(76.9 % higher margin for the cooked meat) (Table 8). In relative terms, in the raw meat, the producer obtained 40 % of the price paid by the final consumer per kg of carcass meat and the intermediaries obtained 60 %. With respect the cooked meat, the producer obtained 25.7 % and the intermediaries 74.3 % of the price paid by the consumer per kg of barbacoa. The absolute and relative margins of the sheep stocking presented the lowest values.

In general, the study reflected lower marketing margin with cooked and raw meat for the producer with respect to the intermediaries; this was similar to what

was found in the marketing of meat of other animal species; for example, in pork meat the producer obtained the lowest relative margin (40.4 vs 59.7 %) with respect to intermediaries, (Sierra *et al.*, 2005), 26.2 vs 73.7 % (González *et al.*, 2010); in beef meat, 43 vs 57 % (Iturrioz and Iglesia, 2009; in goat meat, 4.2 vs 52.7 %; in goat meat as birria, 20.4 vs 79.6 % (Rebollar *et al.*, 2007). In contrast, Abbott (1987) found in sheep meat, 64 vs 36 %; in beef meat 66 vs 34 %; in pork meat, 75 vs 25 % for producers and intermediaries. These results were attributed to the fact that the productive chains of sheep, beef and pork

meat were organized or structured for the marketing of the final product.

In this investigation, the barbacoa seller obtained the greatest part of the total marketing margin, followed by the stocker and the producer (Table 9). The barbacoa seller obtained higher benefit - cost ratios, followed by the stocker and producer, which coincides with Rebollar *et al.* (2007), who reported that goat producer and birria processor obtained the highest benefit - cost ratios, followed by the regional stocker.

Table 8. Mean values of sheep meat marketing margins of cooked (barbacoa) and raw meat in Capulhuac, State of Mexico.

Raw material/Agent	Values	
	Absolute (USD/kg)	Relative (%)
Cooked meat (barbacoa)		
Equivalent value to producer	4.5	25.7
Equivalent value of entrance to *in situ* slaughter	4.6	26.6
Equivalent meat value exit from *in situ* slaughter	6.4	36.3
Gross margin of sheep stocking (2-1)	0.1	0.7
Gross margin of transformation of carcass meat (3-2)	1.7	9.8
Total gross margin of marketing of cooked meat (7-1)	13	74.3
Price paid by the final consumer of cooked meat	17.5	100
Raw meat		
Equivalent value to producer	2	40
Equivalent value entrance at *in situ* slaughter	2.1	42.4
Equivalent value of live sheep to carcass meat	5	100
Gross margin of sheep stocking (2-1)	0.1	1.1
Gross margin of transformation of carcass meat (3-2)	2.9	57.6
Gross margin of marketing of the raw meat (7-1)	3	60
Price paid by the final consumer of raw meat	5	100

Table 9. Structure of costs and profits of the marketing margins by each agent of the sheep meat chain in Capulhuac, State of Mexico.

Agent	Margin (USD/kg)	Costs (USD/kg)	Costs[a] (%)	Profit (USD/kg)	Profit[b] (%)	B/C[c]
Producer	1.9	1.8[3]	94.7	0.1[7]	5.3	1.05
Stocker	2.1	2.0[4]	95.2	0.1[8]	4.8	1.05
Barbacoa seller[1]	5.0	4.4[5]	88.0	0.6[9]	12.0	1.13
Barbacoa seller[2]	17.5	3.1[6]	17.7	14.4[10]	82.3	5.64

[1]Agent that transforms the sheep at *in situ* slaughter to carcass meat.
[2]Agent that transforms carcass meat to barbacoa and pancita.
[3]Sale price of live sheep in corral divided by final live weight of sheep in corral.
[4]Total cost of sheep at plaza or *in situ* slaughter divided by live weight at plaza or *in situ* slaughter.
[5]Total cost of carcass meat divided by the yield of carcass meat.
[6]Total cost of barbacoa and pancita divided by the live sheep (46.4 kg) divided by the yield of the carcass meat to barbacoa and pancita.
[7]Total profit of sale of live sheep in corral divided by final live weight of live sheep in corral.
[8]Total profit of sale of sheep at plaza or *in situ* slaughter divided by live weight at plaza or *in situ* slaughter.
[9]Total profit of sale of sheep meat carcass divided by yield of sheep carcass.
[10]Net profit of sale of barbacoa and pancita of live sheep (46.4 kg) divided by yield of carcass meat to barbacoa and pancita.
[a]Costs, USD/kg multiplied by 100 divided by margin.
[b]Profit, USD/kg multiplied by 100 divided by margin.
[c]Benefit (B)/cost (C) ratio (margin divided by costs, USD/kg). Technical

A relevant aspect that was observed in this study and that is one of the factors that can cause the producers to obtain a lower marketing margin, is that they do not know the characteristics of the product demanded by the stoker or barbacoa seller. This would be minimized if the sheep production and marketing systems adhere to the recommendations of the Mexican norm PROY-NMX-FF-106-SCFI-2006, where the excesses of fat or the poor musculature of the carcass are sanctioned in the price earned by the producer. That's why, it is necessary that different actors form part of the productive chain (producers, marketers, processors, barbacoa sellers, consumers), as well as investigators, technicians and government sectors to recognize the need of integration of a more efficient chain to achieve strategies that improve production (articulated work according to demand). The primary purpose should be to respond to the needs of the market by means of a shared vision of cooperation, communication, and coordination, which would make it possible to identify alternatives and strategies of action that could benefit all of the actors that participate in each one of the production links of sheep meat, thus making it more competitive and equitable at regional or national level.

CONCLUSIONS

According to the present investigation, it is concluded that three sheep marketing channels were identified; the first was producer-stocker-barbacoa selller-consumer. This channel is considered long and with degrees of inefficiency, where the producer receives a low profit with respect to the other agents, which does not motivate him to continue to carry out this activity. A second channel was producer-barbacoa seller-consumer; in this channel, it was observed that the stocker does not participate, which implies a better remuneration to producer. However, this channel is weak because there is no agreement for the sale of the product to the barbacoa seller. Consequently, the stocker may intervene at any time. In any case, it is an alternative channel of higher remuneration for the low investment producers, when there is an agreement of purchase-sale between these actors. A third channel was producer-barbacoa seller (complete cycle), where it was observed that 100 % of the profits were obtained by the producer. In this channel, a certain amount of investment is required, along with organization and knowledge of the elaboration and marketing of the product to the consumer; this producer is open to adopting new technologies for the success of the activity. Finally, with respect to raw and cooked (barbacoa) sheep meat, the producer obtained the lowest marketing margin with respect to the intermediary from the price paid by the final consumer. The producer obtains the highest benefit cost when he carries out the sale of the sheep carcass and barbacoa tacos, pancita and consommé. The profit of this agent is low if the sale is as live animals in plaza or street market.

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