

## Impact of manual and mechanical cut-up of broiler carcasses on the enterprise income

Y. CEVGER, S. SARIOZKAN, H. GULER

Department of Livestock Economics, Faculty of Veterinary Medicine, Ankara University, Ankara, Turkey

**ABSTRACT:** This research was carried out in the Meat and Fish Products Co. Sincan Plant (Ankara, Turkey) between March 2002–May 2002. Total 666 broiler carcasses, 461 of which was cut-up with hand using a knife and 205 of which was cut up with cutting saw, formed the research material. Cut-up carcasses were classified in 6 groups according to their weights. The carcasses were weighted as a whole in both methods and after their weights were recorded, they were cut-up into 4 parts as breast, legs, wings and neck. It was determined that process of cutting up with knife lasted for 60 s and for 17 s with cutting saw. As a result of cutting up, net income increase was determined as 13.82 percent in cutting up with knife and as 15.61 in cutting up with cutting saw with summer prices and as 3.73 percent in cutting up with knife and as 5.6 percent in cutting up with cutting saw with winter prices.

**Keywords:** optimum cut-up weight; marketing style; seasonal differences; shrinkage

One of the most important aspects of economic behavior in the enterprises is to be demand-oriented. This rule is valid also in the enterprises that process chicken meat. Likewise, generally, chicken meat production is one of the sectors that adapted the quickest to the change, which occurred in the consumer preferences, namely in the quality of the demand. Chicken meat is sold as a whole as well as cut-up into parts that give different cooking and taste choices.

This marketing style causes a cost increase as well as an increase of income in the enterprises that produce chicken meat. Comparison of marginal cost and marginal yield occurred as a result of marketing the broiler carcass by cutting-up is extremely important in deciding in the method of marketing.

There are some scientific studies regarding the research subject. Benoff *et al.* (1984) researched the effect of processing with traditional and modern methods on 7–9 week old male and female broilers on meat yield and determined that the most important yield difference between traditional and modern methods was in thigh meat. Heath (1979) compared the part yields obtained from the carcasses cut-up with and without cooling, in his study he made with the aim of determining the

factors affecting yield, quality and consumer preferences in broiler meat. Merkle *et al.* (1980), Bilgili *et al.* (1992), Renden *et al.* (1992), Acar *et al.* (1993) examined the carcass yield and part proportions of eviscerated broiler carcasses on different strains in their researches.

The aim of this study is to inspect the effect of marketing chicken meats with different weights by cutting-up instead of as a whole on the enterprise costs and income, taking into account the carcass weight and seasonal changes.

### MATERIAL AND METHODS

This research was carried out in the Meat and Fish Products Co. Sincan Plant (Ankara, Turkey) between March 2002–May 2002. Weighing records of total 461 pieces (pcs.) broiler carcasses and parts that were grouped as 1 200 g and below (79 pcs.), 1 200–1 399 g (73 pcs.), 1 400–1 599 g (90 pcs.), 1 600–1 799 g (93 pcs.), 1 800–1 999 g (82 pcs.) and 2 000 g and above (44 pcs.) cut-up with hand using a knife, and total 205 pcs. broiler carcasses and parts grouped as 1 200 g and below (29 pcs.), 1 200–1 399 g (31 pcs.), 1 400–1 599 g (39 pcs.), 1 600–1 799 g (39 pcs.), 1 800–1 999 g (40 pcs.) and

2 000 g and above (27 pcs.) cut-up with electric cutting saw formed the material of the research. Electronic scale with 2 g sensitiveness was used in the weighing.

The carcass brought to be cut-up was weighed as a whole after waiting for 1 hour with the aim of having the waters remaining from the chilling process strained. Each carcass, the weight of which was recorded, was cut-up into 4 parts as wings, legs (hindquarter), whole breast (with breast meat, back, bone and skin) and neck.

Parts separated with cutting-up process and cutting angle formed from cutting-up the breast part with knife and cutting saw are indicated in Figure 1.

The parts from each carcass were weighed and recorded separately. During the process of cutting-up, the number of carcasses cut-up by the workers at different times within a 1-hour period was counted and determined. Thus, average labor duration required for 1 carcass was calculated.

Weighing results were assessed on average market prices as of August 2002 for summer term and as of December 2002 for winter term. With these prices, income gained from sales as a whole and income gained from each of the parts were calculated. Income gained from sales as a whole was subtracted from the total parts income. Thus, marginal difference occurred in the enterprise income as a result of cutting-up was determined. It was projected that there would be an increase in production cost due to cutting-up process; labor, energy expenses and

cutting-up shrinkage. Partial budgeting method was used in determining this cost increase (Giles and Stansfield, 1995). Net wage and insurance premium total paid to the workers were taken into account in calculating the increase occurred in labor expenses. Energy expense forms from the electricity cost used in the cutting-up made with a cutting saw. Cutting-up shrinkage was calculated by subtracting the part weights from whole carcass weight.

Average part weights, part proportions, part incomes, part incomes proportions, labor expense per carcass, shrinkage value and net income difference per carcass were determined using weighing results, prices and wages. Net income difference per carcass was determined by subtracting the total of sales income as a whole carcass and expenses (shrinkage and labor) from the total of part incomes per carcass. The results were compared according to carcass weight groups and seasons. Paired-Samples *t*-test was applied for the significance control of difference between groups (Daniel, 1987).

**RESULTS**

In the research, with the duration measurements made throughout the day, it was determined that 1 worker cut-up 1 body in average 60 seconds using a knife and in average 17 seconds with a cutting saw, so as to be ready for package. Percentage shares of average carcass weight and parts in the total part weights are given in Table 1.

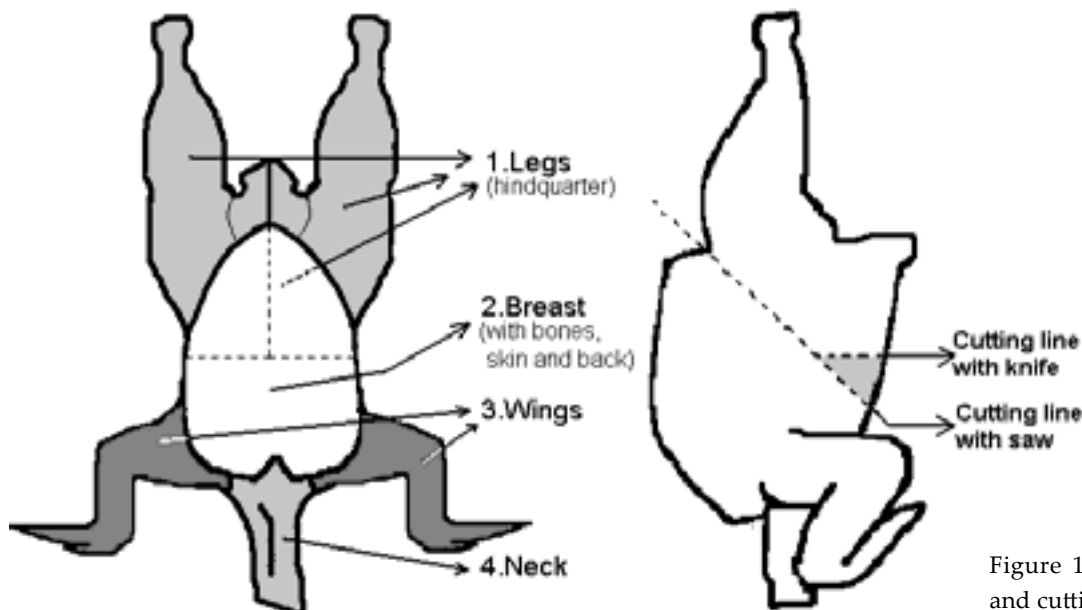


Figure 1. Carcass parts and cutting angles

Table 1. Average carcass weights and proportion of parts weights (%)

Group (g)	Cutting-up with knife					Cutting-up with cutting saw						
	<i>n</i>	Whole (g) $\bar{x} \pm s_x$	Breast $\bar{x} \pm s_x$	Legs $\bar{x} \pm s_x$	Wings $\bar{x} \pm s_x$	Neck $\bar{x} \pm s_x$	<i>n</i>	Whole (g) $\bar{x} \pm s_x$	Breast $\bar{x} \pm s_x$	Legs $\bar{x} \pm s_x$	Wings $\bar{x} \pm s_x$	Neck $\bar{x} \pm s_x$
<1 200	79	1 046 ± 10.19	37.63 ± 0.24	42.21 ± 0.20	12.30 ± 0.10	7.87 ± 0.14	29	1 055 ± 18.18	36.28 ± 0.38	44.43 ± 0.29	11.99 ± 0.14	7.3 ± 0.22
1 200–1 399	73	1 314 ± 6.64	37.71 ± 0.29	42.46 ± 0.21	11.90 ± 0.10	7.92 ± 0.12	31	1 318 ± 8.93	36.23 ± 0.43	44.67 ± 0.31	11.93 ± 0.15	7.17 ± 0.15
1 400–1 599	90	1 494 ± 6.00	38.24 ± 0.21	42.68 ± 0.17	11.48 ± 0.08	7.60 ± 0.11	39	1 494 ± 9.78	36.84 ± 0.30	44.3 ± 0.26	12.02 ± 0.20	6.84 ± 0.17
1 600–1 799	93	1 702 ± 5.95	39.10 ± 0.20	42.34 ± 0.18	11.45 ± 0.07	7.11 ± 0.11	39	1 691 ± 10.19	37.43 ± 0.27	44.38 ± 0.25	11.5 ± 0.17	6.69 ± 0.16
1 800–1 999	82	1 894 ± 6.47	39.17 ± 0.25	42.26 ± 0.20	11.33 ± 0.08	7.24 ± 0.12	40	1 899 ± 9.50	37.82 ± 0.34	44.51 ± 0.29	10.87 ± 0.09	6.8 ± 0.11
≥2 000	44	2 156 ± 23.45	37.90 ± 0.29	43.23 ± 0.28	11.24 ± 0.11	7.63 ± 0.13	27	2 069 ± 10.56	38.43 ± 0.30	43.80 ± 0.20	11.65 ± 0.22	6.12 ± 0.14
Average	461	1 565 ± 16.12	38.36 ± 0.10	42.47 ± 0.08	11.63 ± 0.04	7.54 ± 0.05	205	1 598 ± 23.06	37.18 ± 0.15	44.37 ± 0.11	11.62 ± 0.07	6.83 ± 0.07

Table 2. Percentage shares of part incomes in the total income (%)

	Cutting-up with knife ( <i>n</i> = 461)					Cutting-up with cutting saw ( <i>n</i> = 205)				
	Breast $\bar{x} \pm s_x$	Legs $\bar{x} \pm s_x$	Wings $\bar{x} \pm s_x$	Neck $\bar{x} \pm s_x$		Breast $\bar{x} \pm s_x$	Legs $\bar{x} \pm s_x$	Wings $\bar{x} \pm s_x$	Neck $\bar{x} \pm s_x$	
Summer term	40.53 ± 0.10	42.10 ± 0.09	15.11 ± 0.05	2.26 ± 0.02		39.13 ± 0.14	43.79 ± 0.12	15.04 ± 0.09	2.04 ± 0.02	
Winter term	40.56 ± 0.10	45.40 ± 0.09	11.79 ± 0.04	2.26 ± 0.02		39.09 ± 0.14	47.16 ± 0.13	11.72 ± 0.09	2.03 ± 0.02	

Table 3. Results regarding the shrinkage of cutting-up with knife

Groups (g)	<1 200	1 200–1 399	1 400–1 599	1 600–1 799	1 800–1 999	≥2 000	Average
<i>n</i>	79	73	90	93	82	44	461
Shrinkage (g) $\bar{x} \pm s_x$	6.22 ± 0.66	8.36 ± 0.79	12.62 ± 0.94	14.67 ± 1.65	21.65 ± 2.43	25.54 ± 3.59	14.10 ± 0.75
Shrinkage (%) $\bar{x} \pm s_x$	0.59 ± 0.06	0.63 ± 0.06	0.84 ± 0.06	0.86 ± 0.09	1.14 ± 0.13	1.16 ± 0.16	0.85 ± 0.04
Index <sup>1</sup>	69.43	73.77	98.71	100.93	133.57	136.50	100.00

<sup>1</sup>index: 0.85 = 100

Table 4. Results regarding the shrinkage of cutting-up with cutting saw

Groups (g)	< 1 200	1 200–1 399	1 400–1 599	1 600–1 799	1 800–1 999	≥ 2 000	Average
<i>n</i>	29	31	39	39	40	27	205
Shrinkage (g) $\bar{x} \pm s_{\bar{x}}$	4.34 ± 1.05	6.00 ± 0.89	4.56 ± 0.73	7.33 ± 1.23	11.60 ± 1.46	18.29 ± 3.35	8.45 ± 0.70
Shrinkage (%) $\bar{x} \pm s_{\bar{x}}$	0.41 ± 0.10	0.46 ± 0.07	0.31 ± 0.05	0.43 ± 0.07	0.61 ± 0.08	0.88 ± 0.16	0.50 ± 0.04
Index <sup>1</sup>	82.32	90.81	60.71	85.89	121.35	175.06	100.00

<sup>1</sup>index: 0.50 = 100

Shares of part incomes over summer and winter term prices in the total income are indicated in Table 2.

Results regarding the shrinkage index formed by taking as a base the average shrinkage amount and shrinkage rate and the average shrinkage rate occurred in 1 carcass due to the cutting-up process are indicated in Tables 3 and 4.

Results regarding the gross and net income difference and net income index calculated on summer and winter term prices are given in Tables 5 and 6.

## DISCUSSION

As it is understood from the results regarding the proportion of part weights (Table 1) legs has the greatest share in the total weight. In all weight groups, percent share of legs weight in cutting-up with cutting saw is higher than the value obtained with cutting-up with knife. This situation results from realizing the cutting-up process with a certain angle so as to include some part from the back part in cutting-up with cutting saw (Figure 1). Likewise, since there is no such cutting-up angle in cutting-up with knife with this method, share of breast part in total weight was determined higher than the cutting-up made with cutting saw. In general, results regarding the percentage distribution of the part weights are compatible with the literature data (Moran and Orr, 1969; Orr and Hunt, 1984).

When proportion of part incomes (Table 2) is examined, legs are in the first place in parallel to the weight data according to the both season prices. Percentage share of income gained from leg was determined higher in cutting-up with cutting saw. When inspected according to seasons, it is seen that percentage share of wing in total income increases in the summer term. In winter season share of legs in income increases.

As it is seen in Table 3 and Table 4 in which average shrinkage results occurring due to cutting-up process are given, in cutting-up made with cutting saw, less shrinkage occurs according to cutting-up made with knife. When the shrinkage index results formed taking as a base the general shrinkage rate are inspected, it is seen that; in cutting-up carcasses of 2 000 g and above with knife, 36.5 percent more shrinkage occurs according to average and 75.1 percent more shrinkage occurs in cutting-up with cutting saw.

Table 5. Results regarding gross and net income difference in cutting-up with knife

Group (g)	n	Summer			Winter		
		gross income difference (%)	net income difference (%)	net income index <sup>a</sup>	gross income difference (%)	net income difference (%)	net income index <sup>b</sup>
		$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$		$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	
<1 200	79	15.80 ± 0.15	13.25 ± 0.19	95.92	5.55 ± 0.13	3.53 ± 0.18	94.81
1 200–1 399	73	15.58 ± 0.14	13.44 ± 0.18	97.29	5.50 ± 0.12	3.68 ± 0.16	98.87
1 400–1 599	90	15.47 ± 0.13	13.73 ± 0.18	99.35	5.54 ± 0.11	3.70 ± 0.16	99.41
1 600–1 799	93	15.90 ± 0.15	14.25 ± 0.22	103.12	5.92 ± 0.13	4.19 ± 0.21	112.35
1 800–1 999	82	15.92 ± 0.19	14.59 ± 0.30	105.59	5.53 ± 0.18	3.61 ± 0.29	96.75
≥2 000	44	14.97 ± 0.24	13.18 ± 0.38	95.39	5.20 ± 0.21	3.35 ± 0.36	89.91
	461	15.58 ± 0.07	13.82 ± 0.10	100.00	5.58 ± 0.06	3.73 ± 0.09	100.00

<sup>a</sup>index: 13.82 = 100, <sup>b</sup>index: 3.73 = 100

Table 6. Results regarding the gross and net income difference in cutting-up with cutting saw

Group (g)	n	Summer			Winter		
		gross income difference (%)	net income difference (%)	net income index <sup>a</sup>	gross income difference (%)	net income difference (%)	net income index <sup>b</sup>
		$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$		$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	
<1 200	29	16.25 ± 0.23	15.49 ± 0.29	98.47	6.25 ± 0.21	5.46 ± 0.28	96.47
1 200–1 399	31	16.28 ± 0.19	15.55 ± 0.24	98.86	6.31 ± 0.15	5.55 ± 0.21	98.06
1 400–1 599	39	16.80 ± 0.22	16.25 ± 0.24	103.31	6.73 ± 0.15	6.16 ± 0.18	108.83
1 600–1 799	39	16.63 ± 0.22	15.98 ± 0.28	101.59	6.74 ± 0.17	6.07 ± 0.22	107.24
1 800–1 999	40	16.14 ± 0.16	15.76 ± 0.23	100.19	6.49 ± 0.15	5.67 ± 0.22	100.18
≥2 000	27	16.69 ± 0.23	15.61 ± 0.37	99.24	6.70 ± 0.21	5.60 ± 0.35	98.94
Average	205	16.47 ± 0.09	15.73 ± 0.11	100.00	6.55 ± 0.07	5.66 ± 0.10	100.00

<sup>a</sup>index: 100 = 15.73, <sup>b</sup>index: 100 = 5.66

It was determined that average 15.58 percent gross increase was probable to occur with the summer term prices as an average in the sales income as a result of cutting-up with knife (Table 5) and 5.58 percent gross increase with the winter term prices. Average net income increase data calculated by subtracting shrinkage and labor costs from the gross income increase was determined as 13.82 percent and 3.73 percent, respectively. The net income increase was considered significant from the statistical aspect ( $P < 0.01$ ).

As a result of cutting-up made with cutting saw (Table 6), average 16.47 percent gross increase was recorded with summer term prices and 6.55 percent gross increase with winter term prices, and

average 15.73 percent and 5.66 percent net increase was recorded respectively. The net income increase was considered significant from the statistical aspect ( $P < 0.01$ ).

Since chicken products are consumed rather by grilling in the summer months and demand increases for parts appropriate for such use in tourist regions, price of chicken meat products in parts, especially wing, increases. Therefore, without taking into account the cutting-up method, net income increase occurring in the summer months is higher according to the winter term. Likewise, share of parts in income changes depending on this demand and price change, and share of especially wings in the income increases.

From the determinations made on the general data, it is understood that marketing the broiler carcass by cutting-up instead of as a whole will cause an increase in the enterprise income. However, cutting-up of carcasses with weight under 1 400 g and over 2 000 g seems to cause an increase in the net income according to both season prices, it should be taken into account that parts like wings, breast and legs of this groups' carcasses might be so small or big as to negatively affect the consumer preferences.

Since cutting-up with saw causes less shrinkage and increases labor efficiency, it provides higher net income according to cutting-up with knife.

As a result, as it is also seen from the net income indexes given in Table 5, carcasses between 1 600 to 1 999 g with the summer term prices and between 1 600–1 799 g with the winter term prices cause a net income over the average.

When cutting-up is made with cutting saw, with either summer term prices or winter term prices, carcasses between 1 400–1 999 g cause a net income increase over the average, as seen in the net income indexes given in Table 6.

Therefore, it will be a more rational decision for the enterprise to supply the carcasses to the market by cutting-up, the net income index of which are over 100, also changing according to the methods and terms.

It may be considered to supply the small ones of the carcasses in the groups that provide an income increase below the average as a whole and the carcasses having a weight of 2 000 g and above by processing with more advanced processing techniques like schnitzel, chicken croquet, chicken shish etc.

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### Corresponding Author

Assist. Prof. Dr. Yavuz Cevger, Department of Livestock Economics, Faculty of Veterinary Medicine, Ankara University, Dışkapi 06110 Ankara, Turkey  
Tel. +90 312 317 03 15/324, fax +90 312 316 44 72, e-mail: cevger@veterinary.ankara.edu.tr

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