

CARBON DIOXIDE- AND VACUUM-PACKAGED BOXED BEEF: AN ECONOMIC COMPARISON

William J. Vastine and Thomas L. Sporleder*

Recent events such as the energy situation, the high value of beef byproducts such as bone and fat, increased emphasis on sanitation, and the need for improved labor productivity appear to be stimulants to the growing importance of boxed beef. Potential advantages of boxed beef outweigh the potential disadvantages from the retailers' view, according to Carpenter and Smith (Reference 1). Morris Kreegar, Missouri Beef Packers, Inc., stated that boxed beef offers numerous advantages to both retailers and packers (2). Other meat experts have reached the same conclusion and have predicted that boxed beef will soon become the dominant form of distribution (3).

This publication will help beef suppliers and retailers consider the advantages and disadvantages of two boxed beef distribution methods. Economic comparisons were developed by recording actual costs incurred by a packing plant which used both methods. Implications of the cost comparisons for both suppliers and retailers will be discussed.

Cost-Benefit Comparisons

Procedures. A 1973 study was undertaken to: (1) identify additional costs associated with carbon dioxide- and vacuum-packaged boxed beef being distributed from packer to retailer, as compared to hanging beef; (2) evaluate the two systems with respect to shrink, trim loss and retail case life after 10- and 17-day storage periods; and (3) compare costs and benefits of the two boxed beef methods. A test shipment consisting of 30 boxes of carbon dioxide-packaged I.M.P.S.¹ 103 or 104 ribs, 30 boxes of vacuum-packaged I.M.P.S. 103 or 104 ribs, 30 boxes of carbon dioxide-packaged I.M.P.S. 163 or 164 rounds, and 30 boxes of vacuum-packaged

I.M.P.S. 163 or 164 rounds were monitored to determine shrink, trim loss and retail case life after 10 and 17 days of storage.² The carbon dioxide method consisted of placing about 2 pounds of bagged carbon dioxide pellets into a polyethylene-lined box containing the subprimals. Vacuum packaging involved drawing a partial vacuum on a barrier bag containing a subprimal, which was then boxed.

All costs were reported as *additional costs* that would be incurred in excess of preparing hanging beef. Cost data are reported on a hundredweight basis. Average total costs for vacuum packaging were 106 percent and 27 percent more than for carbon dioxide packaging for ribs and rounds, respectively (Figure 1). Average variable costs accounted for 96.7 to 99.5 percent of average total costs at capacity; thus neither method could be considered capital intensive.

Storage Results. Net benefits per hundredweight for the two methods were determined after 10 and 17 days of storage by adjusting the values of the subprimals for shrink and trim loss, as well as the cost of packaging. However, differences in net benefits were due to trim loss, as there was no measurable shrink.

Small net benefits of 27 cents and 31 cents per hundredweight were realized for vacuum-packaged rounds stored 10 days and ribs stored 17 days, respectively (Figure 2). Vacuum-packaged rounds stored 17 days demonstrated a net benefit of \$2.84 per hundredweight. For subprimal ribs stored 10 days, net benefits of \$2.11 per hundredweight were realized for the carbon dioxide method (Figure 2). This reflected differences in packaging costs, as there was no trim loss for ribs stored 10 days for either method.

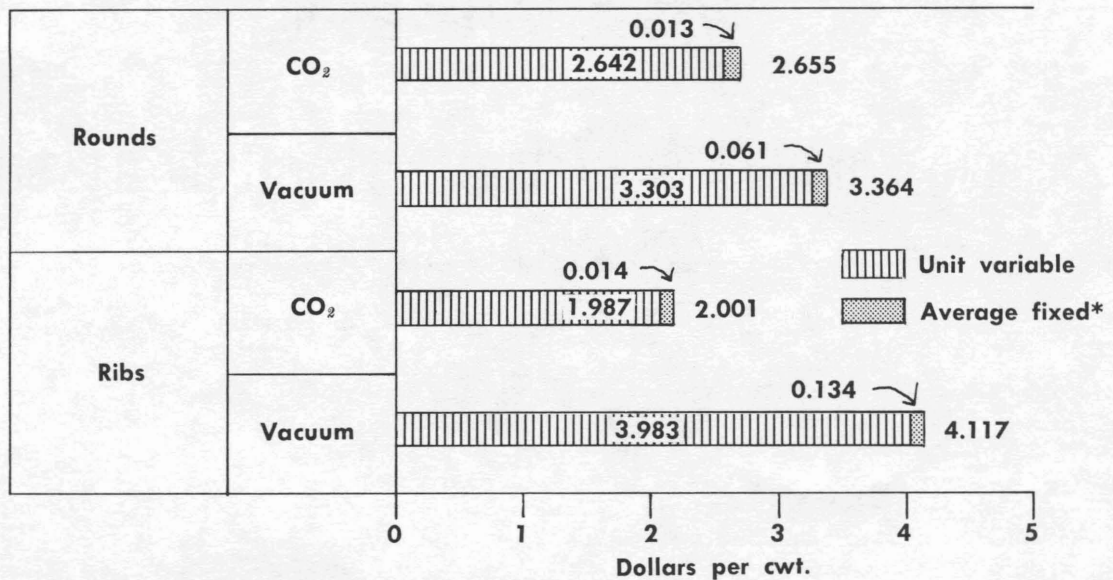
Retail Case Life Results. Retail case life comparisons were made from steaks fabricated from the appropriate subprimals. One-inch-thick steaks were placed on a styrofoam backing board, wrapped with 50 gauge polyvinyl chloride film, and were displayed 4 days under 12-hour intervals of 80 to

*Respectively, Extension economist-marketing-food distribution, The Texas A&M University System; and associate professor of agricultural economics, Texas Agricultural Experiment Station, The Texas A&M University System.

¹Institutional Meat Purchase Specifications. (1)

²For a detailed presentation refer to Reference 5.

Figure 1. Unit variable, average fixed, and average total cost of carbon dioxide- and vacuum-packaged boxed rib and round subprimals, 1973.



*Average fixed and total costs are at capacity.

Source: Reference 5.

Figure 2. Net value comparisons of 10 carbon dioxide- and 10 vacuum-packaged subprimal ribs and subprimal rounds stored 10 and 17 days.

	After 10 days of storage	After 17 days of storage
Ribs¹	Net benefits to carbon dioxide packaging of \$2.116 per cwt.	Net benefits to vacuum packaging of \$0.312 per cwt.
Rounds²	Net benefits to carbon dioxide packaging of \$0.268 per cwt.	Net benefits to vacuum packaging of \$2.84 per cwt.

¹A wholesale value of \$88.50 per cwt. was assumed for ribs.

²A wholesale value of \$80.00 per cwt. was assumed for rounds.

Source: Reference 5

100 foot-candles of incandescent light. Trained meat specialists made daily evaluations of consumer acceptance of each steak for the 4 days. In addition to consumer acceptance scores, an estimate of the number of "pull-backs" was made by recording the number of steaks receiving "undesirable" scores (Figure 3).

With both packaging methods, rib steaks from subprimals stored 10 days maintained desirable average consumer acceptance scores. There was no difference in consumer acceptance scores between carbon dioxide and vacuum packaging after 10 days of storage. After 17 days of storage, rib steaks from vacuum-packaged subprimals received higher consumer acceptance scores than rib steaks from the carbon dioxide packaging method. Average scores

were acceptable for both methods, but were lower for steaks fabricated from carbon dioxide-packaged subprimals after 4 days of display. Estimated number of pull-backs was higher for the carbon dioxide method also.

For both the 10- and 17-day storage periods, inside round steaks from vacuum-packaged subprimals received higher average scores than steaks from carbon dioxide-packaged subprimals for the third and fourth days of shelf life.

Outside round steaks from subprimals stored 10 days had comparable consumer acceptance scores except for the fourth day of retail case life. On the fourth day, outside round steaks from vacuum-packaged subprimals had a higher average consumer acceptance score.

Figure 3. Retail case life comparisons of rib and round steaks from 10 carbon dioxide- and 10 vacuum-packaged subprimals stored 10 and 17 days, 1973.

Steak and storage time	Consumer acceptance scores	Packaging method	Estimated percent pull-backs/day ¹		
			2ND	3RD	4TH
Rib steaks from subprimals stored 10 days	No difference	CO ₂	0	0	10
		V	0	0	10 ²
Rib steaks from subprimals stored 17 days	Vacuum packaging had higher scores after first day of display	CO ₂	0	10	30
		V	0	0	0
Inside round steaks from subprimals stored 10 days	Vacuum packaging had higher scores after second day of display	CO ₂	20	50	70 ²
		V	0	20	30
Inside round steaks from subprimals stored 17 days	Vacuum packaging had higher scores after second day of display	CO ₂	0	10	30
		V	0	10	20
Outside round steaks from subprimals stored 10 days	Vacuum packaging had higher scores after third day	CO ₂	20	50	90 ²
		V	0	10	20
Outside round steaks from subprimals stored 17 days	No difference	CO ₂	0	20	40
		V	0	10	40

¹There were no estimated pull-backs the first day.

²Reflects the effect of an unplanned brief increase in retail case temperature, and demonstrates the importance of temperature control.

Source: Reference 5

Figure 4. Decision guide for selecting carbon dioxide- or vacuum-packaged method for boxed ribs and rounds stored 10 or 17 days.

Price decision guide	Preferred method ¹
If wholesale price/cwt for ribs stored 17 days is:	
A. ≤ \$78.28/cwt	carbon dioxide
B. \$78.29 to \$84.70/cwt	either method
C. ≥ \$84.71/cwt	vacuum
If wholesale price/cwt for rounds stored 10 days is:	
A. ≤ \$45.59/cwt	carbon dioxide
B. \$45.60 to \$73.16 cwt	either method
C. ≥ \$73.17/cwt	vacuum
If wholesale price/cwt for rounds stored 17 days is:	
A. ≤ \$17.50/cwt	carbon dioxide
B. \$17.51 to \$22.49/cwt	either method
C. ≥ \$22.50/cwt	vacuum

¹Represents a 95 percent confidence level.

Source: Reference 5.

Implications for Suppliers and Retailers

- For subprimal rib storage of up to 17 days from kill date, the carbon dioxide method's net benefit was equal to or greater than the vacuum packaging method.
- If more than 2 days of retail case life for ribs was necessary after a subprimal storage period of 17 days, the vacuum packaging method offered a smaller incidence of "pull-backs" than did the carbon dioxide method.
- After 17 days subprimal storage for ribs, the retail case life benefits associated with vacuum packaging might be significant to a retailer.
- For rounds, the vacuum packaging method offered slight net benefits after 10 days subprimal storage. As the subprimal storage period was extended to 17 days, the vacuum packaging method had greater net benefits than the carbon dioxide method.
- Steaks fabricated from the vacuum-packaged rounds had a smaller incidence of pull-backs after the second day of retail case life.
- During the third and fourth day of retail display, steaks from vacuum-packaged subprimal ribs and rounds tended to receive higher consumer acceptance scores than those from the carbon dioxide method. If the results of this case study can be generalized, a possible merchandising advantage is suggested.
- The implications are tempered by the wholesale price of beef used in the analysis. As meat costs increase the cost of trim loss also increases. Vacuum packaging resulted in less trim loss, which means that the net benefits of vacuum packaging would increase with meat prices. Obviously, the converse is also true.
- The following formula can be used to determine

which method is advantageous under varying prices:

$$\text{Break-even wholesale price} = \frac{\text{CO}_2 \text{ packaging cost per cwt} \text{ minus vacuum packaging cost per cwt}}{\text{lbs. trim loss per cwt for CO}_2 \text{ packaging} \text{ minus lbs. trim loss per cwt for vacuum packaging}}$$

- As long as the relative costs and trim losses for the two methods remain constant, decision-makers can use Figure 4 as a decision guide.
- A supplier who must occasionally carry over supplies of subprimals should carefully weigh the advantages of these two methods. Increased trim loss for the retailer lowers his profits, and may cause him to switch suppliers. Thus, inventory control and firmly enforced rotation policies are required to insure a consistent product going to the retailer.
- For retailer and distributor alike, packaging will not substitute for good management.
- Another development that bears watching is vacuum packaging of retail cuts. At least one wholesale firm is experimenting with such a program (6). It is too early to report on their findings but preliminary results are encouraging. Service to remote rural areas appears to be particularly improved as a result of the program. Further study is needed to determine the costs and product characteristics of various methods of boxed beef. For example, the amount of bone in a subprimal may result in different net benefits to packaging alternatives. Essentially, no information is available concerning retail case life evaluations for various subprimal cuts shipped under an array of conditions. As the importance of semi-boneless and boneless beef distribution increases, analysis of costs and benefits of various wholesale and retail packaging methods will be needed.

References Cited

- (1) Carpenter, Z. L. and G. C. Smith, "Boxed Beef - Advantages and Disadvantages At The Retail Level." *Proceedings*, Second Annual Retail Grocers Seminar. October 26, 1973, College Station, Texas. pp. 31-51.
- (2) Kreegar, Morris, "Boxed Beef - Advantages and Disadvantages At The Packer Level." *Proceedings*, Second Annual Retail Grocers Seminar. October 26, 1973, College Station, Texas. pp. 52-58.
- (3) *Meat Buyer's Guide to Standardized Meat Cuts*, 12th printing. National Association of Meat Purveyors. July, 1972.
- (4) *Reports* Vol. II, No. 15. National Live Stock and Meat Board. November 26, 1973. p. 2.
- (5) Sporleder, T. L. and W. J. Vastine, *Comparative Analysis of Carbon Dioxide- and Vacuum-Packaged Boxed Beef: A Case Study*. Research Report, MRC 73-2, Texas Agricultural Experiment Station, The Texas A&M University System. August, 1973.
- (6) Timberlake, William, "Vacuum Packaging Fresh Meats - Preliminary Findings," *Journal of Food Distribution Research*, Proceedings Issue. February, 1974. pp. 29-31.

Educational programs conducted by the Texas Agricultural Extension Service serve people of all ages regardless of socio-economic levels, race, color, sex, religion or national origin.

Cooperative Extension Work in Agriculture and Home Economics, The Texas A&M University System and the United States Department of Agriculture cooperating. Distributed in furtherance of the Acts of Congress of May 8, 1914, as amended, and June 30, 1914.