

Substrate utilization by *Clostridium estertheticum*, the causative organism of blown pack spoilage of vacuum packaged chill stored beef

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'Blown pack' spoilage of vacuum packaged beef typically renders the product unsalable after storage for 3 or 4 wks, which is the median storage life for product distributed in Canada. Thus, blown pack spoilage can result in loss of not only product but also of North American & overseas markets. Outbreaks of blown pack spoilage are sporadic & unpredictable, although in North America they are more frequent in the fall than at other seasons. The causative organisms are usual contaminants of the environments & hides of animals that are transferred to meat during carcass dressing (3). The causative organisms have been identified as the strictly anaerobic psychrotrophs *Clostridium estertheticum* and *Clostridium gasigenes*. However, all reported cases of blown pack spoilage of vacuum packaged beef from North America, Europe or South Africa have involved *C. estertheticum* (3).



Fig. 1. Fresh and blown packs of chill stored vacuum packaged beef.

Blown pack spoilage is characterized by copious gas production in vacuum packs, leading to gross pack distention during chilled storage (Fig. 1). The obligate anaerobic nature of the vegetative cells of clostridia causing blown pack spoilage dictates that the meat surfaces have to be contaminated with the spores prior to vacuum packing & chill temperature storage. Blown pack spoilage of vacuum packaged beef occurs sporadically, with the condition developing in only a fraction of the packs in any consignment (2). While the sporadic occurrence of blown pack spoilage of beef may be due simply to variable contamination of product with spores of *C. estertheticum* (1), the availability in the meat of substrates fermented by the organism may

play some part in determining whether or not blown pack spoilage develops. The availability of low molecular weight substrates in meat are known to affect the growth and spoilage activities of other meat spoilage bacteria (4), but no study of substrate utilization by *C. estertheticum* growing on beef has been reported. Information on that matter might be useful for explanation of the sporadic occurrence of blown pack spoilage, and might indicate possible means for its control.

In a recent study of substrates utilization by *C. estertheticum* cultivated in a meat juice medium (MJM), which is prepared from and contains the low molecular weight, soluble components of raw beef, the organism was found to preferentially utilize glucose (5). Analysis of the growth media showed that *C. estertheticum* grew exponentially on glucose with simultaneous hydrolysis of glycogen (Fig. 2). Growth ceased when glucose in the media was depleted (Fig. 3); but hydrolysis of glycogen continued at a reduced rate, and lactate was consumed rapidly (Fig. 2). The pH values of media fell during growth of the organisms, but rose as the concentrations

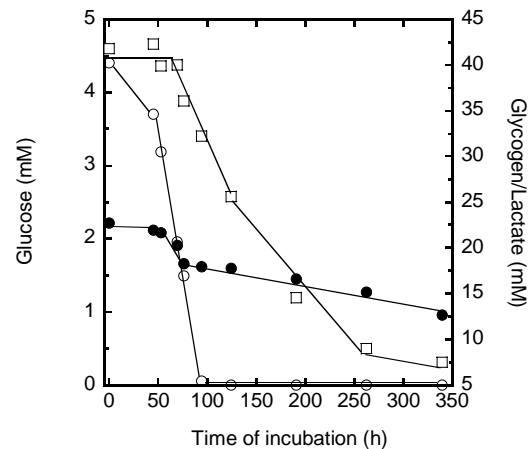


Fig. 2. Values for the concentrations of glucose (○), glycogen (●) and lactic acid (□) in meat juice medium used for the cultivation of *Clostridium estertheticum* subsp. *estertheticum* ATCC 51377 at 10°C for up to 14 days.

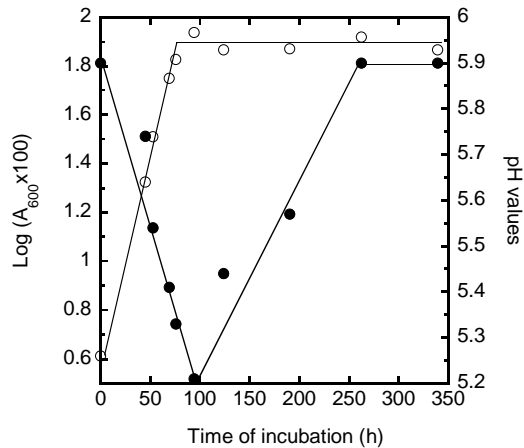


Fig. 3. Values for the log of absorbance at 600 nm ($\log A_{600}$; ○) and the pH (●) of the culture of *Clostridium estertheticum* subsp. *estertheticum* ATCC 51377 growing in meat juice medium incubated at 10°C for up to 14 days.

of lactate subsequently decreased (Figs. 2 & 3). The major products of fermentation during utilization of glucose were butyrate and acetate, with butyrate greatly predominating. During fermentation of lactate the major products were butyrate and butanol, which were produced in similar amounts. The findings suggest that growth of *C. estertheticum* on vacuum packaged beef may be limited by the availability of glucose, as is the growth of other organisms that usually predominate in the flora of vacuum packaged meat. However, production of gas by fermentation of lactate will likely continue after growth ceases. Thus, if *C. estertheticum* is to be a substantial part of the spoilage flora it apparently must compete effectively with the lactic acid bacteria while sufficient glucose is available to support the growth of both it and them.

References:

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