Laboratory Method for Fermentation of Meat and Poultry Sausages in Fibrous Casings

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The construction and operation of a relatively inexpensive cabinet for sausage fermentation studies is described. Temperature can be controlled to ±1 C with a relative humidity of approximately 95%.

Laboratory-scale fermented meat studies have generally employed beakers rather than conventional sausage casings to hold the meat during fermentation (1–3). This “beaker sausage” technique, first described by Deibel et al.

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found with casings, and (ii) the fermented material cannot readily be smoked, cooked out, or dried for possible additional study.

Small commercial scale air-conditioned smokehouses, providing temperature, humid-
ity, and air-flow control, are quite expensive and not always available. Therefore, we designed a simple, relatively inexpensive cabinet-heater combination that will permit fermentation studies in typical fibrous or natural casings.

The cabinet (Fig. 1) was a conventional vat with lid, both made of a reinforced plastic material and of the type previously used for icing down poultry (Model GE798, Goodyear Aerospace Corp., Jackson, Ohio). The vat is available through most meat supply houses. Holes were drilled as shown to accommodate eight stainless-steel rods from which sausage chubs or links were suspended.

Temperature control within the cabinet was achieved with a 16-liter external water bath equipped with a 1,000 W heater-circulator pump. This pump was used to circulate heated water from the external bath to the cabinet via tygon tubing, 9.5-mm inside diameter by 1.6-mm wall (¼ by ¼ inch). A coil of copper tubing, 6.1 m by 9.5-mm inside diameter (20 feet by ¼ inch), in the bottom of the cabinet was connected to the tygon tubing and served as a heat exchanger by transferring heat from the external water bath to approximately 25 liters of water covering the coil in the bottom of the cabinet. Cabinet air temperatures (dry bulb) above the coil-heated water of 30 and 38 C were achieved with external water bath settings of approximately 38 and 52 C, respectively. Sausage material with an initial internal temperature after stuffing of 10 to 12 C rose to 30 C in about 2.5 to 3 h and to 38 C in a total of about 4.5 h. The preceding rates were found for sausage stuffed in 52 mm diameter dry sausage fibrous casings (Union Carbide). Use of smaller or larger diameter casing would change the heat penetration rate.

Humidity within the chamber averages approximately 95%, based on wet-bulb and dry-bulb readings. In industrial practice, a humidity control between 90 to 98% is obtained by introducing steam as the only heat source. It may be possible to achieve a lower humidity, near 90%, through use of various salt solutions although none have been tested in our laboratory.

The rates of pH reduction for replicate sausage fermentations using the above cabinet and an air-conditioned industrial scale smokehouse have shown no significant differences. The rates of pH reduction in these units for a summer sausage mix inoculated with a frozen concentrate of *Pediococcus cerevisiae* (Lactacel, Merck and Co.) and held at 38 C are shown in Fig. 2.

Lactic acid bacteria, as enumerated on the V-8 medium of Fabian et al. (4), were initially (postinoculation) at $8.6 \times 10^8$ cells/g and increased to $6.3 \times 10^8$ cells/g within 24 h.

Studies of microbiological, meat chemistry, physical, and processing parameters involving fermentation with the above system have been reported elsewhere (5-7).

![Fig. 2. Rates of pH reduction during summer sausage fermentation at 38 C in fermentation cabinet (△) and in smokehouse (●).](http://aem.asm.org/)

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