Extension of Shelf-life of Fresh, Whole Broilers, Using a Potassium Sorbate Dip

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ABSTRACT

The shelf life of fresh, whole broilers was extended by dipping freshly chilled carcasses into a 5% (w/v) solution of potassium sorbate for 30 sec. One hundred broilers were removed from a processing line immediately following the final chill tank. Fifty carcasses were dipped in water for 30 sec, and 50 were dipped in the sorbate solution for 30 sec. The birds were allowed to drain and then individually bagged and stored at 3 C until spoilage odors were noted. The control birds were stored for 10 days when spoilage was evident, and the sorbate-treated birds were stored for 19 days, at which time spoilage was evident.

The relatively short shelf-life of fresh, unfrozen poultry has been an industry problem for some time. The initial microbial count greatly influences broiler shelf-life (1). Fresh broilers in retail outlets normally have an initial contamination level of 10^4 to 10^5 microorganisms per cm^2 (4,14,15) and normally can only be stored for 1 or 2 days at 3-5 C and still maintain their freshness (10). The major concern of processors is control of spoilage organisms (Pseudomonas spp.), which produce off-odors and are the cause of consumer rejection (9).

Reviews by Barnes (3), Brune and Cunningham (4), Dawson et al. (5), Mountney (10) and Walker and Ayres (14) have stated the importance of Pseudomonas spp. in causing spoilage of poultry stored at refrigerator temperatures. These organisms cause an off-odor when they are present in high numbers (10^4 cells/cm^2). Extension of shelf-life of fresh poultry, therefore, depends mainly on the control of pseudomonas (7). The most important method to delay spoilage of fresh poultry is to practice good sanitation in the processing plant, and to hold carcasses at or near 32 F (6,10).

Antibiotics (chlortetracycline and oxytetracycline) were used as preservatives for fresh poultry in the early 1960s. Use of 30 ppm of chlortetracycline extended the shelf-life of whole carcasses from 7 to 12 days at 4.4 C (2) in a laboratory test. Vaughn and Stewart (13) reported that it was difficult to ascertain the effect of antibiotics under commercial conditions, that resistant strains of bacteria developed and that the antibiotics were only effective against some bacteria and ineffective against yeasts and molds. Due to the threat of forming antibiotic-resistant strains of bacteria and variable results, use of antibiotics to preserve fresh poultry is no longer allowed. Dawson and Stadelman (6) reviewed the effect of chlorine on fresh poultry. They found that when carcasses were immersed in chill water containing 20 ppm of chlorine, bacterial counts were lower than the control groups for the first few days of storage, but shelf life was not extended.

Perry et al. (11) reported on extension of poultry shelf-life by processing with sorbic acid. Putrid odors were noted in the control breasts after 5 days of storage at 45 F. A treatment with 7.5% sorbic acid spray resulted in a 4-day shelf-life beyond that of the control poultry parts. The authors also noted that after 12 days of storage at 45 F the poultry parts did not exhibit any putrid odor even though bacterial counts were relatively high. Barnes (3) stated that when the chief spoilage organisms are inhibited, organisms producing less offensive odors may be present in much higher numbers without affecting acceptability of the product. Spillage cannot be measured solely by total numbers; one must identify types of organisms present as well. Kaylorereas et al. (6) reported that ice containing glycol difomate and sorbic acid extended the shelf-life of poultry. Robach and lvey (12) reported that a 5% potassium sorbate dip significantly reduced the total plate count of chicken breasts when compared to counts from untreated breasts. The same authors also observed that a 5% potassium sorbate dip markedly reduced growth rate of salmonellae inoculated onto the surface of the chicken breasts. Perry et al. (11) were unable to produce a poultry spoilage microflora capable of growing in the presence of 0.10% sorbic acid. The authors also demonstrated migration of sorbic acid into the poultry muscle.

The purpose of this study was to determine the shelf-life of sorbate-treated broilers and compare it to the shelf-life of conventionally-treated broilers when both groups were held at refrigerator temperatures.

EXPERIMENTAL

Sample preparation

The broilers involved in the shelf-life study were obtained from the Milford, Delaware processing plant of Shorgood Poultry Division, Bayshore Foods, Incorporated.

One hundred freshly slaughtered and chilled broiler carcasses were removed from the processing line immediately following the final chill tank. Fifty birds were dipped in water and 50 birds were dipped in a 5% (w/v) potassium sorbate solution for 30 sec. The birds were allowed to drain, and then were individually packaged in oxygen-permeable polyethylene bags. They were then placed in storage boxes and covered with ice. Eighty carcasses (40 from each group) were air-freighted to the Monsanto Company Research Laboratory in St. Louis, MO and 20 (10 from each group) were left at the processing plant for observation there.
All carcasses were stored at 3°C for the duration of the test. Sorbate analysis was done as described by Robach and Ivey (12). Sensory evaluations (odor and touch) were made daily.

**Total plate count**

Total plate counts (TPCs) were determined at appropriate intervals by swabbing a 1-cm² area inside the body cavity, and external counts were made by swabbing a 1-cm² area of the upper breast. Swabs were made in the same area for each bird. Serial dilutions were made using 0.01 M phosphate buffer (pH 7.2) as the diluent. TPCs were determined in duplicate using Plate Count Agar (Difco). The plates were then incubated at 20°C for 72 h before counting.

**Pseudomonas counts**

*Pseudomonas* counts were determined by plating the swab samples on *Pseudomonas* P-agar (Difco) and incubating plates at 20°C for 72 h. Different colony types were picked and tested for oxidase activity. All isolates were tested using the API-20E differentiation system (Analytab Products, Plainview, NY).

**RESULTS AND DISCUSSION**

A 30-sec dip in 5% potassium sorbate solution left an average residue of 0.12% sorbate (as sorbic acid), based on the weight of the bird. The log phase of growth, as determined by the total plate count was longer for the sorbate-treated broilers than that of the control broilers (Fig 1). Subsequent growth of the microorganisms was not as rapid on the sorbate-treated broilers as was the growth on the control birds. In their review, Elliott and Michener (7) reported that off-odors appeared from poultry when the log number of bacteria reached from 6.5 to 8.0 per square centimeter. They also reported slime formation when the microbial population reached a log number of 7.5 to 9.0 per square centimeter.

Spoilage odors appeared from the control birds on the tenth day of storage at 3°C (Fig. 1). The average log number of bacteria per square centimeter was 6.97 in the body cavity and 6.76 on the breast. Both these log numbers fall into the 6.5 to 8.0 range. The sorbate-treated birds did not exhibit off-odors until the 19th day of storage at 3°C (Fig. 1). The average log number of bacteria per square centimeter was 7.92 in the body cavity and 7.97 on the breast, both numbers being in the 6.5-8.0 range. Figure 2 shows that members of the genus *Pseudomonas* were the predominant bacteria present at the time of spoilage in both the sorbate-treated and control broilers.

Based on both microbiological and organoleptic evaluations, sorbate-treated whole broilers were stored for 19 days at 3°C until considered spoiled, while the control broilers could be stored only 10 days at 3°C before spoiling.

Results obtained in this study are in agreement with reports from Perry et al. (11) and Robach and Ivey (12).

![Graph](http://example.com/graph.png)

**Figure 2.** The effect of a 5% potassium sorbate dip on the *Pseudomonas* count of whole broilers stored at 3°C.

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The author extends his appreciation to George E. McCabe and Pat Sigler of Shorgood Poultry for their cooperation.

**REFERENCES**

The winner of the teaching award this year grew up in a midwestern university town where his father was a teacher. He graduated from his home-town university in 1946 in Dairy Manufacturing and like so many other outstanding people in the dairy industry, earned his M.S. and Ph.D. at University of Wisconsin. He joined the faculty of still another outstanding university, Ohio State, in 1949 and remains there today. Dr. Harper has authored or coauthored over 160 publications, including chapters in books used as texts in dairy manufacturing courses. He has prepared a variety of teaching materials for students, including mimeographs, slide sets, and video tapes. He now teaches 3 undergraduate and 3 graduate courses.

Professor Harper is also active in less formal aspects of teaching. He serves as an advisor to undergraduate and graduate students, is a member of his department's teaching and curriculum committee, and has been a member of a similar college-wide committee. He has contributed to the development of a system for formal evaluation of courses and instructors, of aids to instructors for effective use of new teaching mechanisms, and of systems for student evaluation of courses and instructors.

Perhaps his most unique characteristic as a teacher is an ability to encourage and develop independent thinking, along with correlation of knowledge gained in other courses to solve problems. His students are presented relevant practical problems which require that they utilize prior training, current literature, and logical thought to suggest solutions. Former students express appreciation at having learned this approach to problem-solving.

Dr. Gilliland won the Outstanding Teacher Award in the College of Agriculture after only 3 semesters of teaching at Oklahoma State University. He also serves on the Editorial Board of the Journal of Food Protection.

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