Development of Yeasts on Antibiotic-Treated Poultry

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The predominant type(s) of microbial flora and the changes in types resulting in the particular ascendency pattern on spoiled chicken meat has been a subject of study by various investigators. Ayres et al. (1950) identified the microorganisms contributing to spoilage of chicken meat which had received no treatment other than chilling. Walker and Ayres (1956) concluded that the increase in numbers of organisms on the surface of birds during processing could be attributed to the distribution (by washing and handling) of organisms occurring on the feet and feathers and in the feces and intestinal tract. Yeast were found to be present initially at levels of about 1000 per cm² and after 2 weeks' storage to increase 100-fold. The types found were reported to belong to the genera Rhodotorula, Cryptococcus, and Torulopsis. Ziegler and Stadelman (1955), in reporting the results of work involving treatment of poultry meat with chlortetracycline, state that yeasts having the shape and budding characteristics of Saccharomyces cerevisiae and gram-negative rods formed the predominant flora of the meat treated in this manner. Ayres et al. (1956) found that yeast numbers were higher on chlortetracycline-treated birds than on controls and they indicated that the marked reduction in bacterial numbers may provide a more readily available substrate for yeast development. Njoku-Obi et al. (1957) reported studies on the isolation and identification of the fungal flora of spoiled, chlortetracycline-treated chicken meat. They found representatives of five genera of yeasts to be present on these spoiled carcasses whereas only three genera were found on the spoiled untreated controls. They also commented on the potential pathogenicity of Candida parapsilosis which they isolated from the antibiotic-treated meat.

This report covers a study which was undertaken to gather more information on the yeast types developing on both chlortetracycline- and oxytetracycline-treated poultry meat as well as the increases of spoilage from yeast development after treatment with antibiotics.

**Experimental Methods**

Thirty chlortetracycline (CTC)-treated, 30 oxytetracycline (OTC)-treated, and 30 untreated chicken halves were used in this study. Ten halves of each group were stored at temperatures of 3, 9, and 12C. The chickens were killed, scalded at 60 C for 40 sec, mechanically picked, warm eviscerated, halved, chilled, and treated. Antibiotic treatment consisted of immersing the chilled halves in a cooled solution containing 10 ppm CTC or OTC for 15 min. After treatment, they were cleaned, placed on paper-board trays, and sealed in polyethylene bags. The presence of slime and off-odors were used as indicators of spoilage. Stained smears made from the spoiled birds were examined to determine relative changes in the microflora as storage time progressed.

Yeasts isolations were made on acidified potato dextrose agar. The inoculum for these plates was obtained by swabbing 1 cm² of skin surface with a sterile swab, washing in sterile buffered water, and then making serial dilutions. The plates were incubated at 20 C for 5 days, after which isolations were made. The yeast classification key followed was that of Lodder and Van Rij (1952).

**Results and Discussion**

At 3 C, the percentage of birds showing a predominant yeast flora at the time of spoilage was found to be much greater with the meat which had been given treatment with an antibiotic. Spoilage from overgrowth of yeast is greater for the CTC-treated meat than for that dipped in OTC (table 1). This may be due, however, to the longer storage time obtained by the use of CTC (table 2). Further observations are being made comparing flora at specific times prior to spoilage.

At the higher storage temperatures (9 C and 12 C) none of the antibiotic-treated birds was found to have a spoilage flora which was predominantly yeast. The storage times with antibiotic treatment at these higher temperatures were close to those obtained on untreated birds at 3 C (table 2). None of the untreated birds was found to have a spoilage flora predominantly yeast.

**Table 1**

<table>
<thead>
<tr>
<th>Method of Application</th>
<th>Controls</th>
<th>Chlortetracycline</th>
<th>Oxytetracycline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dipped in antibiotic solution after chilling . . . . . . . . . . . .</td>
<td>0</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td>Antibiotic added to chill tanks . . . . . . . . . . . . . . . . . .</td>
<td>0</td>
<td>30</td>
<td>10</td>
</tr>
</tbody>
</table>
indicating in addition to the competition by bacteria for nutrients the increased time necessary for growth of the slower developing yeasts.

The yeasts isolated from the spoiled poultry which had received no antibiotic treatment were found to consist of members of two genera: Rhodotorula and Torulopsis (table 3). Eighty per cent were of the genus Rhodotorula. R. glutinis made up 40 per cent of the isolations of this group, whereas R. aurantiaca and R. minuta each represented 20 per cent of the types isolated. Torulopsis candida and T. famata accounted for the remainder of types found on these spoiled control birds. These results are in accord with the findings of Walker and Ayres (1956).

The chicken meat which was treated with 10 ppm OTC solutions had a shelf life greater than that of the untreated controls (table 2). One of these OTC-treated chicken halves stored at 3 C was found to have a flora composed very predominantly of yeasts at time of spoilage. Seventy-eight per cent of the yeast types isolated from spoiled OTC-treated meats belonged to the genus Rhodotorula. Similar to the findings with the controls, over one-half of these species were R. glutinis; R. aurantiaca and R. minuta were the other Rhodotorula found. Torulopsis candida made up 21 per cent of all the other types isolated from these birds.

The birds treated with 10 ppm CTC had a longer shelf life than the other two groups but the number of chickens showing predominant yeast flora at time of spoilage was also higher. Three of these birds (held under 3 C storage) were found to be spoiled by overgrowth of yeasts. Species of Rhodotorula still accounted for the largest numbers found on these CTC-treated chickens, representing almost 64 per cent of the yeasts isolated. Torulopsis and Cryptococcus species each accounted for 18 per cent of the identified isolates. Rhodotorula glutinis made up 36 per cent of the isolations of this genus while R. aurantiaca and R. flava accounted for 18 and 8 per cent, respectively. Torulopsis candida and Cryptococcus luteolus were the only other types found.

The number of yeast cells per cm² varied widely within each group but generally they were found to be within the ranges of 1 to 100 million on CTC-treated birds, 100 thousand to 100 million on those treated with OTC, and 10 thousand to 100 thousand on the untreated meats.

These studies indicate in agreement with Ayres et al. (1956) and Njoku-Obi et al. (1957) that the development of yeasts upon antibiotic-treated poultry meat is a result of suppression of competition between the yeasts and the bacterial flora on the birds. There does not seem to be much evidence for assuming that the antibiotics used at the 10 ppm level are directly responsible for yeast growth due to stimulating effects upon the yeast cells, because types, and their relative percentages, as found on the antibiotic treated birds were very similar to the values for the controls. However, Torulopsis candida could be an exception to this. It was found to comprise 17 and 20 per cent of the isolations from CTC- and OTC-treated birds and was not found at all on the controls. Of the yeasts isolated, none were found to be sporeforming and none were found to be pathogenic varieties.

Acknowledgments

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Summary

The development of yeasts upon antibiotic-treated poultry meat was studied. Yeasts isolated from treated and untreated birds fell into the three genera; Rhodotorula, Torulopsis, and Cryptococcus.

A greater per cent of the treated meat had a predominant yeast flora than did the untreated. A greater percentage of chlortetracycline-treated chickens developed yeast spoilage than did oxytetracycline-treated, possibly due to somewhat longer storage times allowed by chlortetracycline and greater reduction of competition by bacteria.

Stimulation of Torulopsis candida by the antibiotic is suggested.

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The Effect of Different Rations on the Number of Free Ruminal Bacteria in Sheep

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The important role played by ruminal bacteria in the nutrition of the ruminants has been recognized for many years. Ruminal bacteria bring about the digestion of cellulose and furnish the host animal with a certain proportion of its amino acids requirements besides many of the water-soluble vitamins (Elsden and Phillipson, 1948; Owen, 1951; Doetsch and Robinson, 1953; Edwards, 1955).

Although a considerable amount of work has been done on the relation of the microflora to the nutrition of cattle, comparatively little has been published on the same subject in sheep. It has been reported that the total counts of ruminal bacteria in sheep are greatly affected by the type of ration (Gall et al., 1948 and 1949a; Moir, 1951; Williams and Moir, 1951; Nottle, 1956). The total numbers of ruminal bacteria varied greatly among different individual sheep fed on the same diet (Moir, 1951; Williams and Moir, 1951).

Marked seasonal fluctuations in total numbers of ruminal bacteria in sheep were attributed by Moir (1951) to changes in protein content of the diet. Nottle (1956) suggested that factors other than diet, such as light and temperature, may cause the seasonal variations.

Williams and Moir (1951) stated that although diurnal variations are considerable, yet, for most types of rations, the concentration of ruminal bacteria is at a minimum before feeding and is maintained at a higher level from 3 to 10 hr after feeding. The results obtained by Nottle (1956) do not agree with the previous statement since he obtained very different curves when sheep were fed on casein and gluten.

The rumen bacteria convert a considerable amount of food protein to their cellular protein, which in turn serves as a protein source for the host animal (McDonald, 1954). Therefore, the total count of ruminal bacteria as influenced by different rations may serve as a good index for the nutritive value of the different diets. Most of the reported counts on ruminal bacteria in sheep were done on samples taken at a certain hr, usually 6 hr after feeding. The results obtained by Nottle (1956) showed that comparisons between such counts do not give a real picture of the influence of various diets on ruminal bacteria. Consequently, this work was carried out to determine the variations in the concentration of free ruminal bacteria of sheep several hr after feeding the animals with different rations. Furthermore, this study is part of a research project initiated by El-Shazly (1958) to study the nutritive value of various Egyptian feeds for the Rahmani sheep. Therefore, more can be learned regarding the relationship between changes in bacterial number and chemical activities that occur in rumen after feeding.

Material and Methods

Experimental animals. Two Rahmani ewes of 2½ years of age were chosen from the sheep flock bred on the college farm because of their similarity in age and appearance.

Each feeding period extended over 3 weeks and the samples were collected on the 20th day because Williams and Moir (1951) have shown that this period is usually sufficient to bring about adjustments of the ruminal microorganisms in sheep. Sometimes, the animals were given rest periods between the different diets as shown in table 1.

Rations. Each animal was offered daily one kg of

References


