Retail Case-Life and Microbial Quality of Pre-Marinated, Vacuum Packaged Beef and Chicken Fajitas

D. K. JONES, J. W. SAVELL, G. R. ACUFF* and C. VANDERZANT

Meats and Muscle Biology Section, Department of Animal Science, Texas Agricultural Experiment Station, Texas A & M University, College Station, Texas 77843

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ABSTRACT

Thirty packages (454 g) each of beef and chicken pre-marinated, vacuum packaged fajitas were obtained from a commercial meat purveyor and placed in a retail case for 16 d. At days 1, 5, 9, 12 and 16, aerobic plate counts (APCs) and microbial types of three randomly selected samples of each product were determined. Samples were also evaluated for surface discoloration, overall appearance, immediate and cooked off-odor and off-flavor. As storage progressed, the pH of products declined, APCs increased and Lactobacillus spp. became dominant in the microflora. Some packaged fajitas, especially chicken, exhibited gas formation in random packages throughout the storage periods. Products became "unacceptable" between 12 and 16 d of retail storage.

Consumer demand for convenience foods and simplification of meal preparation has increased in recent years (2). This report (2) also estimates that ethnic foods, especially Mexican cuisine, will continue to grow in popularity. A grill-ready item consisting of a pre-marinated, spiced, vacuum packaged "fajita" product is one of the many easy-to-prepare Mexican entrees available on the market today.

Fajita is Spanish for "little belt" or "sash" and the piece of meat involved is the diaphragm muscle (outside skirt) or the inside beef skirt steak. Inside skirts are used more often because of availability (6). Fajitas are spiced, grilled and served with tortillas and condiments, such as cheese, sour cream, guacamole and a spicy relish known as pico de gallo. In addition to beef, poultry and pork are also being used. Fajitas were first made popular in many easy-to-prepare Mexican entrees available on the market today.

Retail case-life and microbial quality of these products are major concerns of producers and retailers of grill-ready fajitas. The objectives of this study were to determine the case-life, sensory and microbiological characteristics of pre-marinated, vacuum packaged, beef and chicken fajita products.

MATERIALS AND METHODS

Skinned, vacuum packaged, inside beef skirt steaks and chicken breasts were obtained from beef and poultry processing plants and shipped under refrigeration to a commercial purveyor. The skirt steaks were defatted, subjected to blade tenderization and cut into pieces each weighing about 454 g. The chicken breasts were also trimmed to similar portions. The beef and chicken portions were placed separately into vats containing a marinade consisting of chilled (2-4°C) water, salt, monosodium glutamate, spices, garlic powder, onion powder, and papain. After a 20-min marinating period, the products were vacuum packaged in high oxygen-barrier film (Oxygen Transmission Rate = 7.8 cc/m²/24 h; Moisture Vapor Transmission Rate = 9.3 g/m²/24 h) with adhering spices and marinade, and then frozen at -23°C (the actual marinade formula and the types of equipment used in making these products are proprietary information).

Thirty packages of both the frozen beef and chicken fajitas were shipped to the Meat Science and Technology Center at Texas A & M University and immediately placed in a retail case (2-4°C) with 1614 lux General Electric "natural" fluorescent lighting (lights remained on throughout the display period). Any "leakers" noted throughout the storage times were discarded. Sensory evaluation of the products was conducted by a four-member trained panel on days 1, 5, 9, 12 and 16 of storage for the following traits: surface discoloration (7 = no surface discoloration; 1 = total surface discoloration), overall appearance (8 = extremely desirable; 1 = extremely undesirable), and immediate off-odor (5 = no off-odor; 1 = extreme off-odor). After cooking the products on a Farberware Open-Hearth Broiler (Farberware Company, Bronx, NY) to a medium Hearth Broiler (Farberware Company, Bronx, NY) to a medium degree of doneness (70°C), the panelists, also evaluated cooked off-odor and off-flavor (5 = no off-odor; 1 = extreme off-odor) and off-flavor (5 = no off-flavor; 1 = extreme off-flavor). Panelists were also asked to characterize any perceptible off-odors and off-flavors and to examine packages for gas formation.

Microbial examination of the samples on days 1, 5, 9, 12 and 16 was made as follows. A 10-cm² (2 mm thick) area from the top of each product was removed with sterile forceps and scalpels and placed in separate Stomacher bags containing 100 mL of sterile 0.1% peptone water and macerated in a Stomacher-400 for 1 min. APCs were determined by plating 1 ml (divided over 4 plates), and 0.1 ml of the sample homogenate and 0.1 ml of appropriate dilutions on pre-poured plates.
of tryptic soy agar (TSA, Difco). Plates were incubated for 3 d at 25°C. Two to three of each of the colony types appearing on countable plates were placed on TSA slants and incubated for 3 d at 25°C. Identity of isolates was determined by diagnostic tests and identification schemes described by Vanderzant and Nickelson (9) and Sharpe (4). Each of the colony types now identified to the genus or species level was then expressed as a percentage of the total number of colonies on a countable plate (8). The surface pH of the meat (surface electrode) and the pH of the marinating liquid in the package were determined with an Orion Research Digital pH meter (Orion Research Inc., Cambridge, MA).

Data were analyzed by analysis of variance, and mean separation performed using the Duncan Multiple-range test of the Statistical Analysis System (3).

**RESULTS AND DISCUSSION**

Sensory quality scores of beef and chicken fajitas decreased as refrigerated storage progressed (Tables 1 and 2). Fajitas were judged acceptable at day 12 and unacceptable at day 16. At 9 and 12 d of storage, scores for all quality traits of beef fajitas were consistently numerically higher than those of comparable samples of chicken fajitas.

The largest increase in APC for beef fajitas (Table 3) occurred between days 1 and 5 of storage (log_{10} APC per cm² of 2.20); for chicken fajitas (Table 4) the increase in log_{10} APC over the same period was 1.0, but 2.3 between days 5 and 9 of storage. After day 5 (beef

### TABLE 1. Mean sensory panel scores for pre-marinated beef fajitas stored at 4°C for up to 16 days

<table>
<thead>
<tr>
<th>Storage time (days)</th>
<th>Surface discoloration</th>
<th>Overall appearance</th>
<th>Off-odor</th>
<th>Off-flavor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Immediate</td>
<td>Cooked</td>
</tr>
<tr>
<td>1</td>
<td>6.7bc</td>
<td>7.1bc</td>
<td>5.0b</td>
<td>5.0b</td>
</tr>
<tr>
<td>5</td>
<td>7.0b</td>
<td>7.6b</td>
<td>5.0b</td>
<td>4.9b</td>
</tr>
<tr>
<td>9</td>
<td>6.7bc</td>
<td>6.8ed</td>
<td>4.7c</td>
<td>4.4c</td>
</tr>
<tr>
<td>12</td>
<td>6.3cd</td>
<td>6.6ed</td>
<td>4.2ed</td>
<td>4.4c</td>
</tr>
<tr>
<td>16</td>
<td>6.1d</td>
<td>6.2d</td>
<td>3.9d</td>
<td>4.1c</td>
</tr>
</tbody>
</table>

aMeans are based on 4 evaluations each of 3 replicate samples.  
bMeans in the same column bearing the same superscript letter do not differ (P>0.05).  
cMeans based on 7-point scale (7 = no surface discoloration; 1 = total surface discoloration).  
dMeans based on 8-point scale (8 = extremely desirable; 1 = extremely undesirable).  
eMeans based on 5-point scale (5 = no off-odor; 1 = extreme off-odor).  
fMeans based on 5-point scale (5 = no off-flavor; 1 = extreme off-flavor).

### TABLE 2. Mean sensory panel scores for pre-marinated chicken fajitas stored at 4°C for up to 16 days

<table>
<thead>
<tr>
<th>Storage time (days)</th>
<th>Surface discoloration</th>
<th>Overall appearance</th>
<th>Off-odor</th>
<th>Off-flavor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Immediate</td>
<td>Cooked</td>
</tr>
<tr>
<td>1</td>
<td>7.0b</td>
<td>7.4b</td>
<td>5.0b</td>
<td>5.0b</td>
</tr>
<tr>
<td>5</td>
<td>6.9b</td>
<td>7.3b</td>
<td>4.9b</td>
<td>4.0b</td>
</tr>
<tr>
<td>9</td>
<td>5.7e</td>
<td>5.3e</td>
<td>3.7c</td>
<td>3.2c</td>
</tr>
<tr>
<td>12</td>
<td>6.1e</td>
<td>4.9e</td>
<td>3.1c</td>
<td>3.9d</td>
</tr>
<tr>
<td>16</td>
<td>6.1d</td>
<td>6.2d</td>
<td>3.9d</td>
<td>4.1c</td>
</tr>
</tbody>
</table>

aMeans are based on 4 evaluations each of 3 replicate samples.  
bMeans in the same column bearing the same superscript letter do not differ (P>0.05).  
cMeans based on 7-point scale (7 = no surface discoloration; 1 = total surface discoloration).  
dMeans based on 8-point scale (8 = extremely desirable; 1 = extremely undesirable).  
eMeans based on 5-point scale (5 = no off-odor; 1 = extreme off-odor).  
fMeans based on 5-point scale (5 = no off-flavor; 1 = extreme off-flavor).

### TABLE 3. Numbers and types of bacteria on pre-marinated beef fajitas vacuum packaged and stored at 4°C for up to 16 days

<table>
<thead>
<tr>
<th>Storage time (days)</th>
<th>APC (log_{10}/cm²)</th>
<th>Mic</th>
<th>L. cel</th>
<th>L. plant</th>
<th>L. mes</th>
<th>B. t</th>
<th>Cor</th>
<th>Staph</th>
<th>Ps</th>
<th>H.a</th>
<th>M/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.25b</td>
<td>8.2</td>
<td>56.3</td>
<td>20.0</td>
<td>3.7</td>
<td>0.7</td>
<td>6.7</td>
<td>2.2</td>
<td>2.2</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>7.45e</td>
<td>22.1</td>
<td>71.4</td>
<td>6.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>7.57ed</td>
<td>2.2</td>
<td>6.7</td>
<td>84.4</td>
<td>6.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>8.23de</td>
<td>99.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>7.61ed</td>
<td>32.6</td>
<td>61.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

aMeans are based on data from 3 replicate samples.  
bMeans in the same column bearing the same superscript do not differ (P>0.05).  
Mic = Micrococcus, L. cel = Lactobacillus cellobiosus, L. plant = Lactobacillus plantarum, L. mes = Leuconostoc mesenteroides, B. t = Brochothrix thermosphacta, Cor = coryneform bacteria, Staph = Coagulase negative Staphylococcus, Ps = Pseudomonas, H.a = Hafnia alvei, M/A = Moraxella-Acinetobacter.

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fajitas) and day 9 (chicken fajitas) only smaller increases or decreases in APC occurred.

The microflora of beef fajitas at each of the sampling intervals was dominated by Lactobacillus spp. On the other hand, the microflora of chicken fajitas at day 1 was much less dominated by one type and consisted of Moraxella-Acinetobacter spp., Corynebacterium, Pseudomonas spp., Micrococcus spp., and Bacillus spp. Moraxella-Acinetobacter spp. were dominant at day 5. At day 9 and thereafter, Lactobacillus spp. clearly dominated the microflora, undoubtedly the result of vacuum packaging (7). The initial APC of chicken fajitas indicated that reasonable handling practices had been followed in the preparation of the chicken portions. The initial log_{10} APC (per cm²) of beef fajitas was 5.34, and the microflora consisted primarily of lactic acid bacteria, resulting from vacuum packaged storage of the meat before preparation into fajitas.

The ranges of pH values of meat and marinating sauce of beef fajitas during refrigerated storage were 5.30-5.58 and 5.56-5.78, respectively. The pH values of the meat were 5.34, and the microflora consisted primarily of lactic acid bacteria, resulting from vacuum packaged storage of the meat before preparation into fajitas.

The ranges of pH values of meat and marinating sauce of beef fajitas during refrigerated storage were 5.30-5.58 and 5.25-5.47, respectively (data not shown in tabular form). For chicken fajitas, these pH ranges were 5.56-5.76 and 5.62-5.78, respectively. The pH values of the meat and sauce at the end of the storage period were somewhat lower (0.09-0.18) than the initial values, but the differences were of no practical significance.

Marinade refers to the sauce or mixture of water, salt, spices, tenderizers and often vinegar or citric acid (the sauce used in this study did not contain acid) to tenderize and enrich the flavor of meat. The pH of the sauce was in the range of that of fresh beef. It is possible that some of the spices may have had some inhibitory effect on certain microbial species. The log_{10} APC per g of spice mixture was 4.57 with Bacillus spp. constituting the dominant microbial type. In a few instances, gas production accompanied by sulfide odors was noted in a few packages, primarily the chicken fajitas. It is reported that sulfide odors can be produced by some lactic acid bacteria, Hafnia alvei and Serratia liquefaciens (1, 5, 10). Under the experimental conditions of this study, sensory quality characteristics of the fajitas such as surface color, overall appearance, odor and flavor remained acceptable for 12 days at 4°C. The addition of acid to the marinating sauce could have reduced microbial activity during storage to some extent. A similar trial with beef and chicken fajitas from another purveyor yielded essentially the same values relative to sensory and microbial characteristics of the products (results not shown in tabular form).

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REFERENCES