ABSTRACT

Three poultry chilling methods, namely, water chilling (WC), air chilling (AC), and evaporative air chilling (EAC), were compared to evaluate their effects on broiler breast meat quality and consumer sensory characteristics. A total of 189 birds were processed with 1 of the 3 chilling methods. One-third of the birds were hard scalded (57.7°C, 120 s) and subjected to WC (an ice slurry immersion at 0°C). The remaining birds were soft scalded (50°C, 220 s) and randomly assigned to either AC (blowing air, 1.0 m/s) or EAC (blowing air plus each carcass sprayed with 0.5 L of 0.4°C water) in a chilling room (0.9 ± 0.4°C). Water chilling reduced the carcass temperature most efficiently (57 min), whereas AC and EAC were the least (125 min) and intermediate (93 min) in efficiency, respectively. No significant difference was found among the chilling methods in moisture content, cooking yield, and shear force of deskinned breast fillets stored overnight. However, the pH (5.6) of 24-h stored fillets was higher in WC fillets than in AC (5.5) and EAC (5.5) fillets. For the surface color of skinless breasts, WC carcasses showed a higher Commission Internationale de l’Éclairage (CIE) L* value than AC or EAC carcasses, whereas AC carcasses exhibited more redness (higher CIE a*) and yellowness (higher CIE b*) than the other 2 chilling methods. When raw breast meat was made into cooked gels, no significant difference was observed in cooking loss, moisture content, shear stress, and shear strain, regardless of the chilling method. In consumer sensory evaluations, AC breasts had a higher juiciness score than did WC and EAC breasts, but no significant difference was found for flavor, texture, and overall acceptability.

Key words: water chilling, air chilling, evaporative air chilling, broiler breast

INTRODUCTION

A poultry processing technique referred to as air chilling (AC) has been commercialized in the European Community for more than 35 yr, but more recently, it has been drawing the attention of members of the poultry industry in the United States (Thomson et al., 1975; Carroll and Alvarado, 2008). The primary objective of poultry chilling, regardless of the chilling type, is to reduce microbial growth to a level that will maximize both food safety and product shelf life for consumers and marketing (Sams, 2001). Chilling systems continue to evolve as the industry strives to achieve greater efficiency (shorter chilling), reduce capital costs, improve microbial control, and adjust to changing regulatory requirements without any reduction in product quality (International Commission on Microbiological Specifications of Foods, 2005; James et al., 2006). To date, however, water chilling (WC) has traditionally been used as a major chilling method in the United States (James et al., 2006).

The advantage of WC has recently been challenged by many factors, such as cross-contamination, wastewater management, reshackling, and postchill purge (Bailey et al., 1987; Sams, 2001; Sánchez et al., 2002; Smith et al., 2005; Huezo et al., 2007a,b). In Europe, AC has been commercialized since WC was banned in 1977 (Lillard, 1982). A primary reason for the ban was the potential for increasing cross-contamination during chilling (Thomas, 1977). In AC, the carcasses are usually soft scalded (50 to 53°C) to prevent skin discoloration, whereas hard scalding (60 to 64°C) is preferably chosen for WC because of easier feather removal and a lower bacteria level than the carcasses in soft scalding (Notermans and Kampelmacher, 1975; Sams, 2001). Evaporative air chilling (EAC) also was developed as an alternative to AC, having improved heat transfer and reduced skin discoloration. Recently, several poultry processors in the United States have adopted the
AC technology and have promoted AC chicken, using a premium, natural, or organic brand (Dudlicek, 2005; Gazdziak, 2006).

Chilling methods can have variable effects on broiler carcass meat, both externally (dryness or wetness of the carcass surface, visual appearance of the carcass color, and the purge-related wet pad in tray packs) and internally (shear force, cooking loss, and eating quality; McKee and Sams, 1998; Mielnik et al., 1999; Alvarado and Sams, 2002; Young and Smith, 2004; James et al., 2006; Huezo et al., 2007b; Carroll and Alvarado, 2008; Zhuang et al., 2008, 2009). For breast meat tenderness and sensory properties, Carroll and Alvarado (2008) reported that the shear force value was significantly higher (less tender) in WC fillets than in AC fillets, and that the AC fillets were significantly differentiated by consumer panelists for texture and flavor. Having an ideal texture and improved flavor, AC chicken was reported to be preferred over WC chicken (Veerkamp, 1991; Gazdziak, 2006). However, Huezo et al. (2007b) reported that the color and tenderness of raw and cooked breasts were not affected by the chilling method (WC or AC), whereas fillets from WC carcasses had a significantly lower cooking yield than those from AC carcasses. Mielnik et al. (1999) noted that moisture content in the skin and breast meat, cooking loss, and pH values were the same between AC and EAC. Some data published in the United States have compared the properties of AC and WC on meat quality and sensory profile (Huezo et al., 2007b; Zhuang et al., 2009), but limited research has been conducted comparing the 3 chilling methods (WC, AC, and EAC). Information is needed on the functional characteristics of both raw and processed breasts from different chilling methods because an increasing portion (89%) of raw broiler meat is processed further and marketed (National Chicken Council, 2009). Therefore, the objective of this study was to compare the effects of the 3 chilling methods on raw fillets, processed meats, and the consumer sensory properties of broilers.

**MATERIALS AND METHODS**

**Broiler Carcass Preparation**

A total of 189 male birds (approximately 46-d-old broilers; 63 birds/replication) were obtained from a local broiler producer. In each of 3 replications, the broilers were taken from different flocks of the producer and processed on different days. After withdrawing the birds from feed for 12 h and cooping them in plastic cages, they were transported by truck to the poultry processing facility in the meat laboratory at Michigan State University. On arrival, the birds were electrically stunned for 3 s (40 mA, 60 Hz, 110 V) and bled for 90 s by severing both the carotid artery and jugular vein on one side of the neck. In each replication, 1 group of 21 birds was subjected to hard scalding at 56.7°C for 120 s for WC, whereas 2 groups of 21 birds were soft scalded at 50°C for 220 s for either AC or EAC. The birds were defeathered in a rotary drum picker (SP38SS automatic pickers, Brower Equipment, Houghton, IA) for 25 s. After manual evisceration and washing, each of the carcasses was tagged on the wing and assigned to 1 of 3 chilling treatments.

**Chilling Treatments, Deboning, Storage, and Sampling**

In each replication, 21 hard-scalded carcasses were submerged for WC in a tank of an ice and water mixture (approximately 0°C, 7.6 L/bird) and agitated every 5 min in a chilling room (0.9 ± 0.4°C). After chilling, each carcass was hung by the hocks in shackles on a stainless steel bar and allowed to drip for 5 min. For AC or EAC, each of 21 carcasses from soft scalding was hung by the hocks on a stainless steel bar and exposed to a continuous air flow (1.0 m/s) in the chilling room. Two industrial-size fans (portable air circulator; BF30DD, Ventamatic Ltd., Mineral Wells, TX) were installed to blow cold air toward the carcasses of the 2 chilling treatments. For EAC, cold water (approximately 0.4°C) was manually sprayed (model RL Pro sprayer 997P, Root-Lowell Manufacturing Co., Lowell, MI) onto carcasses (0.5 L/carcass) every 5 min, whereas the carcasses in AC received the blowing air only during chilling. Both temperature (0.9 ± 0.4°C) and RH (87 ± 4%; model 4410 traceable digital humidity/thermometer, Control Company, Friendswood, TX) of the chilling room were monitored every 15 min. In each chilling condition, 1 of the mid-sized carcasses was selected and the internal breast temperature was recorded every 5 min with a digital thermometer/ logger (model 800024, Sper Scientific Ltd., Scottsdale, AZ) until the internal temperature reached 4°C.

On completion of chilling, the carcasses were removed from the shackle line, individually packaged in freezer bags (S. C. Johnson & Son Inc., Racine, WI), and held in the same chilling room before deboning the breasts. After 5 h postmortem, both sides of each breast were manually deboned and skinned. The surface color [Commission Internationale de l’Éclairage (CIE) L* \(a^*\) and \(b^*\)] measurement was immediately taken on the skinless breast fillets. Each of the right and left fillets was individually placed in plastic bags and stored on ice for later analyses. The following day, anterior portions (approximately 20 g) from 10 left fillets/treatment were used to determine pH values and moisture content of raw breast muscle. The remaining portions of the fillets were ground together, made into a cooked gel, and used for the evaluation of moisture content, cooking yield, and torsion values. The other 10 left fillets were cooked for determinations of cooking yield and shear force. For consumer sensory evaluations, all 20 of the right fillets were used.
Color Measurements

Commission Internationale de l’Éclairage L*, a*, and b* values were measured on the surface of skinned raw fillets immediately after chilling by using a chromameter (CR-400, 8-mm aperture, illuminant C; Konika Minolta Sensing Inc., Osaka, Japan) calibrated with a white plate (L*, 97.28; a*, −0.23; b*, 2.43). Six CIE L*, a*, and b* readings (3 readings/side) were obtained for each replication.

pH Value and Moisture Determination

After 24 h of storage, the pH value was measured with a pH electrode (model 13-620-631, Fisher Scientific Inc., Houston, TX) attached to a pH meter (Accumet AR15, Fisher Scientific Inc., Pittsburgh, PA) after homogenizing 5 g of raw meat in 25 mL of distilled, deionized water. Moisture content was determined on each of the raw breasts and cooked gels after 16 to 18 h of drying at 102°C in a drying oven (Yamato DX 400, Yamato Scientific Co. Ltd., Tokyo, Japan) following method 950.46B of AOAC (2000). The weight loss after drying was recorded as the moisture content.

Chicken Breast Gel Preparation, Cooking Yield, and Torsion Test

For the breast gel preparation, each of the left raw fillets (without the anterior portions) was cut into 4 pieces and pooled according to chilling treatment. The pooled meat (1,500 g of meat, 68% of a batch) was first chopped with ice (15%) in a bowl chopper (Vertical-Cutter Mixer 5190, Stephan Machinery Corp., Columbus, OH) for 30 s at 1,500 rpm and then emulsified with additional ice (15%) and sodium chloride (2%) for 2.5 min at 2,100 rpm. The batter was stuffed into preweighed stainless steel cylindrical tubes that were sprayed with vegetable oil to prevent sticking on removal of the cooked gels. The tubes were capped, reweighed, and put into a water bath (model 25, Precision Scientific Co., Chicago, IL) at 80°C for 20 min. After cooking, the tubes were immediately cooled in ice for 15 min, sealed in plastic bags, and stored overnight in a refrigerated room (3°C). The following day, the gels were removed from the tubes, and the 3 parts (cooked gel, empty tube, and cap) were individually weighed to determine cooking yield. Prior to a torsion test, the gels were warmed in plastic bags at room temperature for 2 h and then cut perpendicularly to a length of 3.0 cm by using an adjustable Plexiglas-cutting device. Styrene disks were glued to each end of the testing samples. The samples were then milled into a dumbbell shape (10 mm in diameter at the midsection) by using a shaping machine (KCI-24A2, Bodine Electric Co., Raleigh, NC). Each specimen was placed on a viscometer (DV-III Ultra, Brookfield Engineering Laboratories Inc., Middleboro, MA) and twisted at 2.5 rpm. At the breaking point, both shear stress and shear strain were calculated with the recorded torque and elapsed time by using the equations given by Hamann (1983). Ten specimens were evaluated for each treatment for 3 separate replications.

Cooking Yield and Shear Force Measurements

For the evaluation of cooking yield and shear force, 10 left fillets (aged 24 h) per treatment were individually weighed, placed on stainless trays on a stainless steel rack, and covered with foil. The fillets were cooked to an internal temperature of 76.7°C in a preheated convection oven (Bloccos-101/AA, The G. S. Blodgett Corp., Burlington, VT) at 177°C following USDA-Food Safety and Inspection Service (2001) guidelines. Temperature was monitored with 2 thermocouples inserted to the thickest parts of 2 breast samples on 2 trays. Both thermocouples were attached to a digital thermometer/logger (model 800024, Sper Scientific Ltd., Scottsdale, AZ). During cooking, all trays were rotated once for uniform cooking. After cooking, the fillets were removed from the trays, individually wrapped with foil, and stored overnight at 3°C in plastic bags. The following day, the cooked breasts were brought to room temperature and weighed again to determine cooking yield. Cooking yield was calculated by the following equation: (cooked breast weight)/(raw breast weight) × 100. Shear force was determined according to the razor-blade method described by Cavitt et al. (2004) and Meullenet et al. (2004). A texture analyzer (TA-HDi, Texture Technologies Corp., Scarsdale, NY) was calibrated with a 5-kg load cell; the razor blade (height, 24 mm; width, 8 mm) was set at 10 mm/s, and the test was triggered by a 10-g contact force. The shear force value (N) was calculated as the maximum force recorded during the shear. Two shear force measurements per breast fillet were made.

Consumer Acceptance Evaluations

A total of 210 consumer panelists (70/replication) evaluated the broiler breasts (20 right fillets/chilling) chilled by 1 of 3 chilling treatments. The panelists recruited were students, staff, and faculty members at Michigan State University. After 24 h of storage, the breasts were cooked according to USDA-Food Safety and Inspection Service (2001) guidelines, as described previously for cooking yield. Immediately after cooking, the central portion of each breast was trimmed to approximately 5 × 6 cm. The trimmed breasts were then wrapped with aluminum foil and kept at 60°C in a warmer (RO230-C, 22-Quart Roaster Oven, Rival, Milford, MA) until sensory testing was completed within 2 h. On serving, the prepared breast was cut again into 4 pieces (approximately 12 to 15 g; a total of 80 pieces/treatment). One piece from each treatment was
labeled with a 3-digit random number and placed on a polyfoam tray with a cover. The tray, with 3 samples, was randomly presented to each panelist. Both filtered water and unsalted crackers were provided for mouth cleansing between samples. Sensory evaluations were conducted in individual booths equipped with a touch-screen computer and controlled lighting. Questionnaires were prepared and data were collected using Sensory Information Management Systems software (Sensory Computer Systems, Morristown, NJ). Panelists were asked to evaluate the samples for flavor, texture, juiciness, and overall acceptability on a 9-point hedonic scale (9 = like extremely; 1 = dislike extremely). They were also encouraged to make comments on their decisions.

**Statistical Analysis**

All experiments were replicated 3 times. Data were statistically analyzed using the GLM procedure of SAS (SAS Institute, 2002) as a randomized block design. If significance was determined ($P < 0.05$) in the model, dependent variable means were separated using the least significant difference procedure of SAS (SAS Institute, 2002). Consumer sensory evaluation data were pooled across panelists and analyzed as described previously.

**RESULTS AND DISCUSSION**

Carcass chilling time is one of the critical parameters in the design of any chilling system, and carcass temperatures have been noted to affect meat quality (James et al., 2006). In this study, the internal temperature of carcasses before chilling was 40.7°C, which was reduced to 4°C or below during chilling, with average times of 57, 125, and 93 min for WC, AC, and EAC, respectively (Figure 1). These results are similar to the trend shown in previous research (James et al., 2006; Zhuang et al., 2009). Huezo et al. (2007a) found that the initial internal temperature of carcasses before chilling averaged 32.8°C and that the chilling times to 4.4°C were 35 and 90 min for WC and AC, respectively. The lower initial temperature and reduced chilling time were due to the different processing conditions: their carcasses were transported from a commercial processing line to the laboratory before measuring the initial breast temperatures and subsequent chilling. Veerkamp (1985) and Mielnik et al. (1999) noted that, compared with AC, EAC had an increase in heat transfer by the evaporation of water.

The pH values of broiler breasts, measured after chilling and holding for 24 h postmortem, are shown in Table 1. Water-chilled breasts had a higher pH value (5.6) than did AC (5.5) and EAC (5.5) breasts, which were not significantly different. Previously, Huezo et al. (2007a) indicated that more portions of WC fillets, compared with AC fillets, had pH higher than 5.8 at 150 min postmortem, probably because of an accelerated rigor mortis in the extended AC. Carroll and Alvarado (2008) reported other results of the higher pH in AC than in WC. However, their outcomes were obtained from broiler fillets chilled differently in different plants, which might not be an accurate reflection of 24-h pH had the broilers been processed in the same facility and from the same flock. In the case of AC and EAC, no significant pH difference between the 2 chilling methods was found in our study, which was similar to the report of Mielnik et al. (1999).

None of the 3 chilling methods (WC, AC, and EAC) resulted in a significant difference ($P > 0.05$) in moisture content and cooking yield of broiler breasts measured after 24 h of storage (Table 1). Similar results were also reported in 2 separate research studies, which showed no moisture difference between WC and AC after 24 h of storage (Zhuang et al., 2008) and no moisture difference between AC and EAC (Mielnik et al., 1999). Hale and Stadelman (1973) indicated that the weight gained in WC was lost during storage of the fresh product. It appeared that the absorbed water in WC simply came out as purge during value-added cutting and overnight storage, and did not increase muscle moisture content or cooking yield. When breast fillets were marinated, AC fillets had a higher solution pickup and cooking yield than WC fillets, which was expected because of the increased moisture loss and ability to retain more marinade than the WC fillets (Huezo et al., 2007b; Carroll and Alvarado, 2008).

Both Allo-Kramer and Warner-Bratzler shear force have commonly been used for evaluating tenderness in broiler breast meat, but a razor-blade method was recently introduced as more advantageous in predicting poultry meat tenderness (Cavitt et al., 2004; Meullenet et al., 2004). In this study, the shear force value of cooked breast meat was determined by the razor-blade method after 24 h of storage (Table 1). Although no differences ($P > 0.05$) in shear force values were determined among the 3 chilling treatments, WC breast...
meat had a numerically (13.7 N) higher value than AC breast meat (12.0 N) or EAC breast meat (11.4 N). Similarly, Huezo et al. (2007a) found that the Allo-Kramer shear values of WC fillets were approximately 2 kg/g higher, with no statistical difference, compared with the shear values of AC fillets when the fillets were deboned at approximately 3 h postmortem. In 2008, Carroll and Alvarado observed that shear force was significantly higher (less tender) in WC fillets than in AC fillets when deboned at 24 h postmortem.

On chilling and deboning at 5 h postmortem, the 3 chilling methods affected the surface color of broiler breast fillets (Table 1). Water chilling resulted in the highest (P < 0.05) CIE L* value of breast fillets, whereas AC showed the lowest (P < 0.05) CIE L* value (darker) among the 3 chilling methods. Similarly, Carroll and Alvarado (2008) and Mielnik et al. (1999) found that AC breasts had a lower L* value (darker color) than WC or EAC breasts. For redness, the CIE a* value was the highest (P < 0.05) in the AC breasts, and no significant difference (P > 0.05) was found between WC and EAC breasts. For yellowness, AC breasts had a higher (P < 0.05) CIE b* value than WC breasts, and EAC showed an intermediate value.

Several research studies have reported no significant difference between WC and AC in L*, a*, and b* values of raw breast fillets (Fleming et al., 1991; Huezo et al., 2007b; Zhuang et al., 2009). However, Huezo et al. (2007b) noted a significant correlation between the weight loss of AC carcasses and the color values of raw breast fillets: the higher the weight loss of AC carcasses, the lower the L* values and the higher the a* values of raw fillets. They also speculated that the increase in L* values of WC carcasses may have resulted from the removal of water-soluble proteins (myoglobin, hemoglobin, and cytochrome C).

The cooked breast gels stored for 24 h were evaluated for moisture content, cooking yield, and textural properties (shear stress and strain; Table 2). Moisture content and cooking yields of the gels were not significantly affected by any chilling method. These results were coordinated with the previous observation of no moisture difference in the raw fillets (Table 1), although the moisture content on the surface of fillets might not be the same, considering the different L* values (Table 1). In accordance with the moisture and cooking yield results, shear stress and strain values of the cooked breast gels among the 3 chilling treatments were not significantly different. Both gel structure and firmness were reported to be closely related to water-binding ability and protein integrity (Hermansson, 1979; Hammann and MacDonald, 1992).

Table 3 shows the mean consumer sensory scores of cooked breast fillets evaluated by 210 individuals. Overall, the scores for flavor, texture, and overall acceptability were similar (P > 0.05) in all breast samples, indicating that the 3 chilling methods did not affect sensory properties. Similarly, Zhuang et al. (2009) reported that the flavor and texture profiles of AC broiler breasts were not different from those of WC samples. Pedersen (1982) obtained similar results for odor, tenderness, and overall acceptability when comparing AC and WC chicken. Among the 3 chilling methods in this study, AC resulted in a juiciness score (P < 0.05) high-

### Table 1. Effects of chilling methods on the properties of raw and cooked broiler breast fillets

<table>
<thead>
<tr>
<th>Property</th>
<th>Water chilling</th>
<th>Air chilling</th>
<th>Evaporative air chilling</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pH</strong></td>
<td>5.6 ± 0.02a</td>
<td>5.5 ± 0.02b</td>
<td>5.5 ± 0.02b</td>
</tr>
<tr>
<td><strong>Moisture (%)</strong></td>
<td>75.1 ± 0.13a</td>
<td>75.4 ± 0.21a</td>
<td>75.6 ± 0.10a</td>
</tr>
<tr>
<td><strong>Cooking yield (%)</strong></td>
<td>75.9 ± 1.32a</td>
<td>74.4 ± 1.07a</td>
<td>75.5 ± 1.24a</td>
</tr>
<tr>
<td><strong>Shear force (N)</strong></td>
<td>13.7 ± 1.25a</td>
<td>12.0 ± 0.34a</td>
<td>11.4 ± 0.40a</td>
</tr>
<tr>
<td><strong>a</strong>*</td>
<td>53.4 ± 0.28a</td>
<td>49.6 ± 0.29f</td>
<td>51.1 ± 0.26b</td>
</tr>
<tr>
<td><strong>b</strong>*</td>
<td>2.9 ± 0.11b</td>
<td>3.4 ± 0.09b</td>
<td>3.0 ± 0.09b</td>
</tr>
<tr>
<td><strong>L</strong>*</td>
<td>2.6 ± 0.14b</td>
<td>3.4 ± 0.22a</td>
<td>3.0 ± 0.19b</td>
</tr>
</tbody>
</table>

*a* Means ± SE within a row without no common letter are different (P < 0.05).

### Table 2. Effect of chilling methods on moisture content, cooking yield, and functional properties of gels made from broiler breast meat

<table>
<thead>
<tr>
<th>Property</th>
<th>Water chilling</th>
<th>Air chilling</th>
<th>Evaporative air chilling</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moisture (%)</strong></td>
<td>78.8 ± 0.06a</td>
<td>78.8 ± 0.16a</td>
<td>78.7 ± 0.12a</td>
</tr>
<tr>
<td><strong>Cooking yield (%)</strong></td>
<td>85.8 ± 2.46a</td>
<td>85.3 ± 1.68a</td>
<td>86.5 ± 1.93a</td>
</tr>
<tr>
<td><strong>Shear stress (kPa)</strong></td>
<td>25.6 ± 0.67a</td>
<td>25.8 ± 0.64a</td>
<td>25.7 ± 0.84a</td>
</tr>
<tr>
<td><strong>Shear strain</strong></td>
<td>1.3 ± 0.05a</td>
<td>1.3 ± 0.04a</td>
<td>1.4 ± 0.04a</td>
</tr>
</tbody>
</table>

*a* Means ± SE within a row are not different (P < 0.05).

1*All values were measured from the cooked and 24-h stored gels. Number of observations in each chilling, n = 10 (moisture); 15 (cooking yield); 30 (shear stress/strain).
er than those for WC and EAC, which were similar to each other. Similar results were observed by Lee et al. (2008), who reported that both AC products (no water added) showed higher juiciness scores than 2 of the 4 WC products (2 for 15% chicken broth-enhanced products; 2 for products with 2 to 3% water retained) when the 6 different commercial brands (2 AC and 4 WC products) were evaluated. The only WC product obtaining higher tenderness than the AC product was from the chicken enhanced with 15% chicken broth.

In conclusion, 3 values (pH, color, and juiciness) of broiler fillets were affected by the 3 different chilling methods (WC, AC, or EAC). Water chilling, rather than AC or EAC, showed the most efficient chilling rate. In the consumer sensory test, no treatment difference was found among the 3 chilling methods, with the exception of higher juiciness scores for the AC samples.

To date, WC has been a common chilling method in the United States, mainly because of the chilling efficacy and absence of weight loss. Currently, the generic advantages of WC are being challenged by the water shortage, cost of waste management, and revised USDA rules. Water chilling appears to have some straightforward advantages during chilling; however, AC possesses more potential advantages after chilling, such as reduced water consumption, reduced waste management, and a juicier product. Additional information is required on the overall benefits of the 3 chilling methods to compare not only the poultry chilling rate, but also the entire processing, including product safety, value-added processing, the reduction in fresh water consumption, and environmentally friendly processing for the future.

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