Textural and Sensory Properties of Pork Jerky Adjusted with Tenderizers or Humectant

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Abstract

This study was carried out to investigate the textural and sensory properties of pork jerky with differently added sources of tenderizer or humectant at final concentrations of 2 or 5% (v/w). Pork jerky treated with 5% glycerol, kiwi, or pineapple had lower moisture content and water activity than that of control pork jerky ($p < 0.05$). The addition of tenderizer or humectant resulted in a lower shear force than that of control ($p < 0.05$). The addition of 2 or 5% glycerol resulted in higher equilibrium moisture content (EMC) than other treatments, and addition of tenderizer or humectant produced a higher EMC than that of control ($p < 0.05$). Furthermore, addition of pineapple and kiwi to the samples affected the structures of the myosin heavy chain and the actin filaments of myofibrillar protein, respectively. Trained panel sensory evaluations indicated that pineapple enhanced the flavor score, whereas tenderness score was improved by the addition of tenderizer or humectant ($p < 0.05$).

Key words: pork jerky, tenderizer, humectant, texture, sensory property

Introduction

Jerky is made from sliced whole muscles which have been marinated and dried. It is relatively simple to process, with a typical flavor, and usually requires no refrigeration during commercial distribution, due to low water activity (a_w). Jerky products can be made with various marinade techniques, meats from different species and drying conditions (Han *et al.*, 2007; Pegg *et al.*, 2006; Yang *et al.*, 2009). To achieve stability, jerky is dried to a_w 0.70-0.85 (Quinton *et al.*, 1997) and is shelf-stable at a 0.75:1.00 moisture protein ratio. Also, efficacy of the jerky making processes in inactivating foodborne pathogens has been evaluated by several researchers. For example, Harrison *et al.* (1997) have studies inactivation of selected pathogens in whole muscle and have determined that allowing the product to reach an internal temperature of 71.1°C prior to drying at 60°C inactivates

pathogens that could pose a health hazard to consumers. However, whole muscle jerky is very lean, and may be too dry, or brittle, and may have the undesirable color typical of over-dried meats (Miller *et al.*, 1996). Some comminuted jerky-type products have a softer texture, but also high fat and a_w , resulting in activation of lipid oxidation and microorganism (Quinton *et al.*, 1997).

Tenderness is the main factor which contributes to the overall eating quality of meat (Mori *et al.*, 2001) and is considered to be the most important factor by the average consumer in many countries. The jerky's texture can be altered by the moisture content, as is done for other intermediate moisture (IM) meats (Farouk and Swan, 1999). One such item under development is a shelf stable jerky product, in which a_w is controlled by adjustment of moisture and the incorporation of glycerol (Barrett *et al.*, 1998). Several studies were undertaken to determine the effect of glycerol on properties of IM meat. Guilbert *et al.* (1981) found that the addition of 5% glycerol was effective in reducing a_w . Textural effects can be obtained by the adjustment of either water or glycerol levels, as both substances can potentially plasticize the protein matrix (Barrett *et al.*, 1998). Lowering a_w by reducing moisture

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Therefore, this experiment was aimed to establish the allowable limits of different tenderizers or humectant such as kiwi, pineapple, glycerol and sorbitol to be utilized in dried pork jerky, from texture and sensory point of view.

Preparation of dried pork jerky samples

night, sliced into pieces of 0.5 cm thickness with a meat slicer (HFS 350G, Hankook Fugee Industries Co. Ltd., Seoul, Korea) and cut into cubes of $10.0 \times 4.0 \times 0.5$ cm. Sliced muscles were cut parallel in direction to muscle fibers. The pork jerky was produced according to the following recipe from Yang *et al.* (2009). Curing ingredients (based on raw meat weight) were bought from a local food additives plant included salt, sugar, sodium nitrite (Kukje chemical Co., Busan, Korea), sodium erythorbate (Hyupsung Co., Busan, Korea), glycerol (Seojinchem, Ulsan, Korea), D-sorbitol (Roghetta, Ulsan, Korea), kiwi and pineapple. Kiwi used in this study was of the *Hayward* variety grown in the Gyeongnam and pineapple (*Ananas comosus* L. Merryl) was obtained from Philippine. Kiwi and pineapple were ground through a 5 mm plate and homogenated at 5,000 rpm for 60 sec using a homogenizer (GG-22, NSF Korea). Kiwi and pineapple juices were obtained after filtering the solid ingredients off of homogenates, respectively. Samples were cured with 1.5% salt, 1.0% sugar, 0.02% sodium nitrite and 0.03% sodium erythorbate, added with glycerol, sorbitol, kiwi or pineapple made at levels of 2 or 5% (v/wt). Nine different treatments were prepared: 1) non-added control, 2) added 2% liquid glycerol, 3) added 5% liquid glycerol, 4) added 2% liquid sorbitol, 5) added 5% liquid sorbitol, 6) added 2% kiwi juice, 7) added 5% kiwi juice, 8) added 2% pineapple juice, and 9) added 2% pineapple juice (Table 1). For each batch of muscle samples and other ingredients were cured thoroughly at 4°C for 24 h. All cured muscle samples were dried using a dryer (DS80-1, Dasol Scientific Co. Ltd., Hwaseong, Korea) at an internal temperature of 70°C, 70% to 40% relative humidity for 8 h. Samples were then taken for water activity, to a target $a_w < 0.85$. There was adequate air distribution between samples received the same drying treatment. After drying and cooling to ambient ($\approx 25^\circ\text{C}$) temperature jerky samples were loosely packed, without vacuum, in water im-

Table 1. Formula of pork jerky treated with tenderizers or humectant

[illegible]

permeable plastic bags (single package). Jerky samples were subjected to analysis of moisture content, water activity, shear force, color, moisture absorption capacity, SDS-polyacrylamide gel electrophoresis and sensory evaluation.

Moisture content and water activity

Moisture content was determined according to AOAC methods (AOAC, 2000). The total moisture content of 5 g of finely chopped samples placed in aluminum moisture dishes were determined from their pre-dry and dry weights (dried in an air oven at 100°C for 24 h) and expressed as the percentage of pre-dry weight and gram of water per gram of dry weight. The moisture content was determined in triplicate on each jerky product.

Three pieces of dry jerky samples from each treatment were selected and cut into small pieces using sharp scissors and homogenized prior to measurement of water activity. The pieces were put into water activity cups, and their water activities were determined with a water activity meter (AQS-2, Nagy messsystem, Germany), which had been calibrated at ambient temperature (20°C) with distilled water ($a_w = 0.999$) and saturated solutions of NaCl ($a_w = 0.756$) and KCl ($a_w = 0.853$).

Texture property

Texture property was determined using the Instron Universal Testing Machine (Model 3343, US/MX50, A&D Co., MA, USA). Cross-sections of pork jerky samples as close as practicable to 0.5×4.0 cm (approximately 2.0 cm²) was cut sample for shear force measurements. The cross-sections of samples were placed at a right angle to the blade. Crosshead speed was 100 mm/min and full scale load was 10 kg.

Color analysis

The surface color of the pork jerky samples was measured by the CIE L^* , a^* , b^* system using a Minolta chromameter (Model CR-310, Minolta Co. LTD., Japan) standardized with a white plate ($L^* = 89.2$, $a^* = 0.921$ and $b^* = 0.783$). The measurements for each of five replicates were taken. Lightness (L^*), redness (a^*) and yellowness (b^*) values were recorded (CIE, 1986).

Moisture adsorption capacity (MAC)

Water adsorption capacity measurements were conducted using dehydrated pork jerky samples following procedures described by Yang *et al.* (2007). Prior to dehydration, the samples were prepared with tenderizer or humectant. All samples were then frozen at -70°C (Clean

vac 8, Biotron, Korea) and freeze-dried over a 3 to 5 d period. Dried and ground samples (approximately 1 g each) were put into polystyrene weighing dishes (0.0508 m², Fisher Scientific Co.) and further dehydrated in a vacuum desiccator over P₂O₅ for 5 to 7 d until constant weight was attained. The dehydrated samples were equilibrated at 25°C in sealed chambers over various saturated salt solutions with known relative vapor pressures (RVP); LiCl (0.11), KCH₃ (0.23), MgCl₂ (0.33), K₂CO₃ (0.43), Mg (NO₃)₂ (0.53), KI (0.69), (NH₄)₂SO₄ (0.81) and KNO₃ (0.93). Equilibrium moisture content (g H₂O/g solid) was calculated from the weight gain after no further change in weight had occurred. Triplicate samples from each treatment were measured.

SDS-polyacrylamide gel electrophoresis (SDS-PAGE)

Jerky samples (2 g) were added to 20 mL of rigor buffer containing 75 mM KCl, 10 mM K₂HPO₄, 2 mM MgCl₂, and 2 mM EGTA, pH 7.0 and homogenized with a polytron homogenizer (T25basic, IKA, Malaysia). The homogenate was centrifuged at 10,000×g, 4°C, for 10 min, after which time, supernatant was decanted. Fresh rigor buffer 20 mL was then added to the pellet and the homogenization (P1) was repeated. This process was repeated to obtain P1-P3. The P3 was used for myofibril fractions. SDS-PAGE was performed according to the method of Laemmli (1970). Protein solutions were mixed at 1:1 (v/v) ratio with the SDS-PAGE sample treatment buffer (0.25 M Tris-HCl pH 6.8, 4% SDS, 20% glycerol, 10% 2-mercaptoethanol, 1% bromophenol blue) and heated at 100°C for 1 min in a heating block (Digi-Block®5402, Electrothermal, USA) and applied to the gel. Each samples (1 mg/mL) was loaded on the gel made of 4% stacking and 15% separating gels and subjected to electrophoresis at a constant current of 10-20 mA per gel using a mini-gel electrophoresis unit (Might Small™ SE 245, Hoefer Scientific Instruments, USA). After electrophoresis, the gels were stained with 0.1% Coomassie brilliant blue R-250 in 40% methanol and 7% acetic acid and destained with 40% methanol and 7% acetic acid. Molecular weights of protein bands were calculated using standard marker (M-0630, Sigma, USA). The density of each band on a gel was measured with a gel documentation analysis system (EDAS 290, Kodak, Japan).

Sensory training and evaluation

Ten panelists (GNU: Gyeongsang National University students, faculty, and staff) were recruited and trained in 3 training sessions. Ten panelists were screened from 13

potential panelists using basic taste identification tests. Panelists were given samples representing anchor points for each attribute, and training sessions using pork jerky without tenderizer or humectant (control) and pork jerky with tenderizer/humectant treatments (2 or 5% glycerol, sorbitol, kiwi and pineapple) produced in the GNU meat lab. The samples were evaluated for cooked pork flavor ("5 extremely intense" and "1 slightly intense"), tenderizer or humectant flavor intensity ("5 extremely intense" and "1 slightly intense"), juiciness ("5 extremely juicy" and "1 no juicy"), toughness ("5 very tough, and 1 not tough), and cured color intensity/redness ("5 extremely red" and "1 slightly red"). Final anchor point ratings were decided upon by training panel after initial evaluation and discussion. They were trained with commercial jerky products for 2 weeks (three sessions per week) with the product characteristics to be evaluated. The panelists evaluated the samples for appearance, color, flavor, juiciness, toughness and overall acceptability using a 9-point hedonic scale as described by Meilgaard *et al.* (1999). The panelists evaluated each characteristic of the sample using a 9-point hedonic scale, where one (1) was "dislike extremely" and fifteen (9) was "like extremely." Samples were cut no more than 30 min prior to the sensory evaluation and pieces were held in zippered plastic bags to prevent drying. The samples were transferred into glass containers [Pyrex (Pyrex, USA)] with plastic cover before the sensory test started. Panelists evaluated samples in isolated booths fitted with a breadbox server.

Statistical analysis

Data from three replications were analyzed by analysis of variance (ANOVA) using statistical analysis systems (SAS). ANOVA was adapted to designing mathematical model using SAS 8.2 (SAS Institute, Inc., USA). Duncan's multiple range test was used to determine the statistical significance among the means (SAS, 2002) at 95% significant level.

Results and Discussion

Moisture content, water activity and shear force

The moisture content, water activity (a_w) and shear force of the pork jerky samples with tenderizers or humectants are shown in Table 1. Pork jerky samples showed significant differences in moisture content and water activity ($p < 0.05$). The samples with 2% glycerol and 2 or 5% sorbitol added showed a higher moisture content than the control. On the other hand, those samples to which

were added kiwi and pineapple showed significantly lower moisture content than those of the control pork jerky sample ($p < 0.05$); the percentage of moisture content of the pork jerky was affected by the addition of these tenderizer or humectant. Pineapple had slightly less moisture (18.51-19.02%) than the other treatments and control. In general, jerky texture can be altered by the moisture contents, but jerky manufacturing methods also include extrusion and infusion of meats with tenderizer or humectant to lower a_w (Chang *et al.*, 1991). Also, commercial IM foods have moisture contents of 20 to 40% (Jose *et al.*, 1994). Pork jerky is classified as an IM meat product with moisture content of about 20 to 25% (Chen *et al.*, 2002).

There were significant differences among the a_w of the pork jerky samples which underwent the same drying conditions. The results of 2% glycerol and 2 or 5% sorbitol added to pork jerky samples showed a higher a_w than that of the control pork jerky sample. However, the water activity of the pork jerky samples was 0.74, 0.75, 0.74 and 0.73 for 5% glycerol, 5% kiwi, 2% pineapple and 5% pineapple, respectively. 5% glycerol, kiwi and pineapple added pork jerky samples showed significant differences, with lower a_w than the control pork jerky sample ($p < 0.05$). In the previous studies, the samples were dried to achieve an acceptable a_w for proper shelf-life. The shelf-life of IM meat products decreases with higher moisture content and a_w , due to inhibition of microbial growth (Gould and Christian, 1988). The final IM products reached a constant a_w of 0.70-0.75 and were then ready for consumption, and would normally be shelf-stable for 6 months, unpacked (Torres *et al.*, 1994). Also, Yang *et al.* (2009) reported that a_w of dried whole muscle pork jerky varied from 0.794 to 0.822, which is lower when compared to beef jerky. Glycerol is an effective additive for the control of a_w (Linko *et al.*, 1985). Barrett *et al.* (1998) reported that a_w could be reduced from 0.90 to 0.85 with a 28% increase in firmness by adding 4% glycerol. Therefore, it is essential that IM meat products such as jerky should be dried to a_w acceptable for proper shelf-life.

One of the most important attributes of jerky is the hardness, which can be measured as shear force. Shear force values can be used to characterize the IM products and can also define differences in total cutting force. In this study, shear force was defined as the maximum force attained as a blade sheared through pork jerky samples, and the results are shown in Table 1. The addition of tenderizer or humectant produces lower shear force com-

pared to the control ($p<0.05$) and 2% sorbitol added to the samples showed the lowest shear force value compared to all other treatments. The results were identical to those reported by Barrett *et al.* (1998), indicating that the glycerol can act as an effective textural plasticizer in certain meat products. Chen *et al.* (2000) reported that the shear force of pork jerky decreased significantly with increased levels of glycerol. The enzymatic tenderization have either been investigated or applied to improve meat tenderness (Cheftel and Culioli, 1997). Our results, however, demonstrated that the softer pork jerky can be made with 2 or 5% tenderizer or humectant, and changes in quality can be due to lower moisture content and a_w .

Color analysis

Color of the pork jerky samples with/without tenderizers is shown in Table 2. 5% glycerol showed a significantly lower lightness (L^*) than control ($p<0.05$). These results indicate that the addition of 5% glycerol is useful in preparing pork jerky which results in a darker processed meat. The addition of glycerol for darker beef stick samples can be produced by increasing the glycerol level (Barrett *et al.*, 1998). Darkening as a result of reduced a_w was the only effect discernible by the eye. Several researchers reported enzymatic or non-enzymatic browning in meat, due to the reactivity of fruit or glycerol with protein (Sherwin and Labuza, 2003). However, the addition of sorbitol, kiwi and pineapple did not show a significant difference in L^* compared to the control. The redness (a^*) of the pork jerky samples differed significantly. The addition of tenderizer or humectant produces higher a^* , and the addition of 2% glycerol, 2% sorbitol, 5% kiwi and 2 or 5% pineapple resulted in a significantly higher a^* than control ($p<0.05$). The addition of 2% kiwi

produced higher yellowness (b^*) compare with other jerky samples ($p<0.05$).

Water adsorption capacity

To further investigate why the addition of tenderizer or humectant to pork jerky produced lower shear force value, water adsorption measurements were also conducted with samples of the dried pork jerky. The dehydrated samples were prepared with tenderizer or humectant. Fig. 1 represents the moisture adsorption capacity of dehydrated and powdered samples with tenderizer or humectant added, prior to dehydration. As shown in Fig. 1, at low a_w range ($a_w<0.53$) the equilibrium moisture content (EMC) were at similar values. For example, EMC at 0.93 a_w was 0.40 g H_2O /g solid and 0.34 g H_2O /g solid for samples with 5% and 2% glycerol added, respectively. The addition of 2% and 5% glycerol to the samples resulted higher EMC than the other samples. Also, the addition of tenderizer or humectant produced higher EMC than the control ($p<0.05$). Decrease in shear force by the addition of tenderizer or humectant must be due to increased water retention property in response to drying.

SDS-polyacrylamide gel electrophoresis

The electrophoresis pattern of myofibrillar proteins of

Table 2. Moisture content, water activity and shear force of pork jerky treated with tenderizers or humectant¹⁾

Treatments	Moisture content (%)	Water activity	Shear force (kg/cm ²)
Control	25.57±1.00 ^b	0.81±0.01 ^c	7.14±0.77 ^a
2% glycerol	28.06±0.49 ^a	0.83±0.00 ^b	4.68±0.57 ^{cde}
5% glycerol	21.85±0.31 ^c	0.74±0.01 ^g	4.94±0.43 ^{cde}
2% sorbitol	27.59±0.70 ^a	0.83±0.00 ^b	4.14±0.64 ^e
5% sorbitol	27.77±0.59 ^a	0.85±0.00 ^a	4.23±0.29 ^{de}
2% kiwi	22.42±0.76 ^c	0.79±0.00 ^d	5.69±0.65 ^b
5% kiwi	21.63±1.73 ^c	0.75±0.00 ^e	4.97±0.52 ^{bcd}
2% pineapple	19.02±0.14 ^d	0.74±0.00 ^f	5.21±0.72 ^{bc}
5% pineapple	18.51±0.52 ^d	0.73±0.00 ^h	5.08±0.49 ^{bcd}

¹⁾Data are expressed as means±SD, $n=3$.

^{a-b}Values with different superscripts within a column are significantly different ($p<0.05$).

Fig. 1. Moisture adsorption capacity of pork jerky treated with tenderizers or humectant. Control, pork jerky without tenderizer; G2, treated glycerol 2%; G5, glycerol 5%; S2, sorbitol 2%; S5, sorbitol 5%; K2, kiwi 2%; K5, kiwi 5%; PA2, pineapple 2%; and PA5, pineapple 5%. G, S, K and PA indicate glycerol, sorbitol, kiwi and pineapple, respectively. $n=3$.

the pork jerky samples with tenderizer or humectant is shown in Fig. 2. According to the SDS polyacrylamide gel patterns, differences in myofibrillar protein fractions among 2% added treatments (A) could be observed in this study. Probably, because the pineapple sample was more affected by the enzymes present in the pineapple; hence myosin heavy chain of myofibrillar protein was more influenced than other samples. According to the results, 5% (B) pineapple added sample showed higher degradation of myofibrillar protein (myosin heavy chain, α -actinin and actinin) than 2% pineapple sample. Brooks *et al.* (1985) reported that the changes of chicken muscle were caused by crude papain treatment using densitometric tracing on SDS gels. According to SDS-PAGE profiles which showed degraded fragments of meat proteins, progress in digestion was clearly observed on both myo-

sin heavy chain (MHC) and actin, by papain and bromelain, into lower molecular weight fragments with time (Kim and Taub, 1991). Wada *et al.* (2002) reported that actinidin had fewer disaggregation changes than the actin control. This indicates that the 5% kiwi sample has higher degradation of myofibrillar protein (myosin heavy chain) than did the 2% kiwi sample. Furthermore, these enzymes have very broad specificities to break down the major muscle proteins (Miller *et al.*, 1989). These findings indicated that the addition of pineapple and kiwi could affect the structure of the actin and myosin filaments of myofibrillar protein. The results of this study followed the same pattern as in the studies reviewed above.

Sensory evaluations

The sensory panels were convened to assess the effects on the color, flavor, juiciness, tenderness and overall acceptability of pork jerky samples with tenderizer or humectant (Table 3). Sensory evaluation data of pork jerky indicated that the level and type of tenderizer had an effect ($p < 0.05$) on color, flavor, juiciness, toughness, and overall acceptability. The pork jerky products with 2% glycerol added produced higher color scores than did the control ($p < 0.05$). Flavor scores were increased by the addition of the tenderizer. The samples with 5% pineapple added showed higher flavor scores than the control ($p < 0.05$). Toughness scores in the pork jerky products were improved by the addition of a tenderizer or humectant, especially in the samples with kiwi and pineapple ($p < 0.05$). Overall, with regard to the flavor and toughness characteristics, the samples with added kiwi and pineapple had higher likeability scores than did the control pork jerky sample. Chen *et al.* (2000) demonstrated that Chinese-style pork jerky with glycerol and sorbitol had better

Fig. 2. SDS polyacrylamide gel patterns of myofibrillar protein of pork jerky treated with tenderizers or humectant. M, denote protein molecular mass standard; Control, pork jerky without tenderizer; G2, treated glycerol 2%; G5, glycerol 5%; S2, sorbitol 2%; S5, sorbitol 5%; K2, kiwi 2%; K5, kiwi 5%; PA2, pineapple 2%; and PA5, pineapple 5%. G, S, K and PA indicate glycerol, sorbitol, kiwi and pineapple, respectively. $n=3$.

Table 3. Color (CIE L^* , a^* , b^*) of pork jerky treated with tenderizers or humectant¹⁾

Treatments	Lightness (L^*)	Redness (a^*)	Yellowness (b^*)
Control	37.44±0.74 ^a	8.54±1.65 ^b	8.34±1.22 ^{bc}
2% glycerol	35.54±0.99 ^{ab}	10.98±2.02 ^a	8.07±0.79 ^{bc}
5% glycerol	31.04±0.52 ^b	10.50±1.98 ^{ab}	6.22±0.91 ^c
2% sorbitol	34.26±2.86 ^{ab}	10.94±2.02 ^a	8.56±3.13 ^b
5% sorbitol	33.26±2.87 ^{ab}	10.12±1.06 ^{ab}	5.81±0.67 ^c
2% kiwi	37.78±5.80 ^a	9.83±0.79 ^{ab}	12.93±0.72 ^a
5% kiwi	36.18±0.24 ^{ab}	11.09±1.12 ^a	10.79±1.86 ^{ab}
2% pineapple	36.21±3.21 ^{ab}	11.34±2.56 ^a	10.01±1.39 ^{ab}
5% pineapple	35.56±1.17 ^{ab}	11.41±0.55 ^a	10.37±0.19 ^{ab}

¹⁾Data are expressed as means±SD, $n=3$.

^{a-b}Values with different superscripts within a column are significantly different ($p < 0.05$).

Table 4. Sensory evaluation of pork jerky treated with tenderizers or humectant¹⁾

Treatments	Color ²⁾	Flavor	Juiciness	Toughness	Overall acceptability
Control	6.10±1.42 ^{bc}	4.00±2.16 ^b	5.83±2.08 ^{ab}	3.73±1.89 ^b	4.37±0.57 ^d
2% glycerol	7.87±1.40 ^a	4.13±1.40 ^b	4.87±0.51 ^{ab}	5.27±0.40 ^{ab}	4.70±0.60 ^{cd}
5% glycerol	6.03±0.35 ^{bc}	5.43±1.12 ^{ab}	4.00±0.55 ^b	5.17±0.47 ^{ab}	5.63±0.60 ^{bcd}
2% sorbitol	6.37±0.40 ^{abc}	5.60±0.66 ^{ab}	5.33±0.91 ^{ab}	5.77±0.59 ^{ab}	5.93±0.12 ^{abcd}
5% sorbitol	5.87±0.96 ^{bc}	5.50±0.75 ^{ab}	5.20±1.01 ^{ab}	5.80±0.70 ^{ab}	6.10±0.61 ^{abcd}
2% kiwi	5.00±0.10 ^c	5.57±0.67 ^{ab}	5.60±1.02 ^{ab}	6.70±1.25 ^a	6.47±0.45 ^{abc}
5% kiwi	5.50±0.46 ^{bc}	5.23±1.70 ^{ab}	5.77±1.37 ^{ab}	6.97±1.46 ^a	5.80±0.66 ^{bcd}
2% pineapple	6.10±0.78 ^{bc}	7.23±2.64 ^a	5.93±1.36 ^{ab}	7.27±1.42 ^a	7.87±1.89 ^a
5% pineapple	6.83±1.36 ^{ab}	7.53±1.72 ^a	6.47±1.46 ^a	7.50±1.8 ^a	7.23±2.01 ^{ab}

¹⁾Data are expressed as means±SD, *n*=3.

²⁾Based on a 9-point intensity scale (1=dislike extremely or extremely bland/tough/dry/undesirable; 9=like extremely or extremely intense/juicy/tender/desirable).

^{a-b}Values with different superscripts within a column are significantly different (*p*<0.05).

sensory scores for hardness and chewiness when compared to samples without these particular additives. Also, Choi *et al.* (2008) reported that the instrumentally low shear force and high tenderness of jerky made from ground and restructured meat is a desirable attribute for the consumer. Sensory evaluations indicated that pork jerky with kiwi and pineapple was also well-liked, as were the glycerol and sorbitol jerky samples. Thus, the inclusion of kiwi and pineapple may offer additional natural tenderizers, thereby improving acceptability in dried pork jerky products.

Conclusion

Results from this study demonstrate that pork jerky with various tenderizer and humectant have less moisture content and lower *a_w* than the control sample. Moreover, pork jerky made with treated tenderizer or humectant samples had lower shear force values than the controls. These findings indicated that the addition of pineapple and kiwi affected the structure of the myosin and actin filaments of myofibrillar protein, and with added glycerol samples had the higher EMC than the control. Further research into the sensory evaluation indicated that acceptability of pork jerky could be enhanced by the addition of various tenderizers. In particular, the addition of natural meat tenderizers, such as kiwi and pineapple, result in increased flavor, tenderness and an overall increased acceptability score.

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