TENDERIZATION OF YAK MEAT BY PLANT EXTRACTS

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Abstract – Tenderness is the most vital organoleptic trait influencing consumer acceptance to meat. Yak meat is the main meat source for Tibetan people and considered as Green foods in China, its consumption and value, however, are impaired by its toughness due to long raising time of animals. The objective of the current study was to tenderize yak meat, *per se Longissimus dorsi* in this study by using aqueous extract of plants, including ginger (GE) and kiwi extract (KE). Each extract alone or their mixture was injected into meat before vacuum packaged and stored at 4 □ for 21 days. Lipid oxidation, myoglobin oxidation, pH value, color, cooking loss and shear force were evaluated on day 0, 7, 14 and 21. The results showed that the treatment by the mixture of two plant extracts could inhibit lipid oxidation and improve tenderness more effectively than ginger or kiwifruit extract used separately (*P<0.05*), indicating the existence of a synergistic effect of ginger and kiwifruit extract toward the tenderization of yak meat. The optimal concentration for tenderizing yak meat and inhibiting lipid oxidation at 0.18% GE + 0.13% KE (V/W) was obtained. Neither ginger, or kiwi extract alone, nor their mixture influenced pH value, color, cooking loss, and myoglobin oxidation in yak meat (*P>0.05*).

Key Words – Plant extract, Tenderness, Yak meat

• INTRODUCTION

Tenderness is the most important organoleptic trait influencing consumers' satisfaction to beef palatability, consumers are willing to pay a higher price for the tenderness guaranteed beef [1]. Known as the "Beef Crown" in China and the main food source for Tibetan people, yak meat is nutritious and restorative, however, it is rather tough due to the long raising time of animals by nature-pasturing, e.g. 4 years for mature and even 6-year-old animals are slaughtered, compared with usually 2-3 years for cattle. Therefore yak meat is usually not considered as high quality meat from the aspect of tenderness and color appealing.

A large number of attempts have been made to improve beef tenderness, while treatment with proteolytic enzymes derived from plants, such as papain, bromelain, and ficin, has been a widely proven attempt to improve the tenderness of yak meat. Further studies reported that plant extracts could be applied directly on tenderizing yak meat [2]. When compared with the commercial proteolytic enzymes treatment, plant extract approach could give a moderate and lasting tenderizing effect on meat, while avoid unfavorable taste and over tenderization usually caused by unequal distribution of proteolytic enzymes [3]. Previous study also reported that injection-enhancement of ginger extract had an application prospect in tenderizing *Biceps femoris* [4]. Accordingly, proteases derive from ginger and kiwi respectively can degrade myofibril and collagen proteins, resulting in tender meat [5, 6]. The previous correlative studies utilized either ginger extract or kiwi extract separately, however, there was no study to combine these two plant extracts to improve yak meat tenderness more effectively.

Therefore, the objective of our study was to evaluate effect of ginger (GE) and kiwi extract (KE) on the tenderness of *Longissimus doris* of yak. The present study was to develop practical applications of plant extract in tenderizing yak meat and could be applied at household and industrial level in order to improve the quality of yak meat.

• MATERIALS AND METHODS

Longissimus dorsi were obtained from 12 adult Maiwa yaks (3-4 years age) within 1-2h post - slaughter from Hongyuan County (2 batches, 6 yaks for each). They were packed in polyethylene sample bags and stored in a 4□ refrigerator for 24 h. Then muscles were cut into small chunks of approximately 6cm×6cm×6cm size for different treatments. Injected and non-injected chunks were all vacuum packaged and stored at 4 □ for 21 days. Lipid oxidation, pH, instrumental color, cooking loss, myoglobin oxidation and shear force were evaluated on day 0, 7, 14 and 21.

Original ginger and kiwi extracts preparation.

Fresh ginger rhizome and kiwi were purchased from a local market. Both of them were washed, peeled, sliced and then blended with equal quantity of chilled distilled water using a blender (Model WF2212112, Waring Commercial, Torrington, USA) for 1-2 min. The slurry was then filtered with 2 layers of cheese cloth and filtrates were collected as the original GE and KE respectively, which would be diluted with distilled water to reach the required concentration before injection.

Sample injection treatments

Two batches of *Longissimus dorsi* were used in the two stages in this study. In the first stage, chunks from the same animals were equally divided into 4 groups, which would were injected with distilled water, 0.28% GE (V/W), 4.6% KE (V/W), and the mixture of two extracts (0.14% GE + 2.3% KE) .The final weight of injected samples increased by 110% of their original weight. Based on the grouping methods described by previous studies [4, 7] with minor modification, our treatments were set as follows:

Control, C: distilled water; GE-treated, G: the final concentration of GE in yak meat was 0.28% GE (V/W); Mixture of GE and KE, GK: the final concentrations in yak meat were 0.14% GE (V/W) and 2.3% KE (V/W), respectively; KE-treated, K: the final concentration in yak meat was 4.6% KE (V/W).

For the second stage of this study in which the second batch of animals were used, in order to obtain the optimal ratio of these two plant extracts when synergistic effect exists, chunks from the same yak were equally divided into 4 groups, and injected distilled water, 0.091% GE + 0.13% KE (V/W), 0.18% GE + 0.13% KE (V/W), 0.23% GE + 0.26% KE (V/W) respectively, and the final weight of sample reached 110% of their original ones. According to the previous studies [2, 4], in the present study, the injection treatments were set as follows with some modification.

Control, C: distilled water; Low concentration of mixture-treated; LC: the final concentrations of two extracts in yak meat were 0.091% GE (V/W) and 0.13% KE (V/W), respectively; Medium concentration of mixture-treated, MC: the final concentrations of two extracts in yak meat were 0.18% GE (V/W) and 0.13% KE (V/W), respectively; High concentration of mixture-treated, HC: the final concentrations of two extracts in yak meat were 0.23% GE (V/W) and 0.26% KE (V/W), respectively.

Determination of pH, meat color, myoglobin oxidation, and cooking loss

The determination of pH was performed with an acidometer (Model PHS-25, Shanghai TecFront Electronics Co., Ltd. Shanghai, China), through thrusting a plug-in electrode into the position at least 2cm under surface of chunks. CIE L*, a*, and b* values were measured at three random locations on each chunk using a Konica colorimeter (Model CM-2500d, Konica, Japan). For measurement of cooking loss, chunks were cooked to an internal temperature of 75 □ in a water-bath. After an over-night cooling at 4 ℃, then weight of meat

was recorded, before that, the raw weight (weight before cooked) was recorded as well. Cooked weight was divided by raw weight and the result was multiplied by 100 to give the percent cooking loss. As reported by Stewart *et al*. (1965), the assay of myoglobin oxidation of samples was performed [8].

Determination of lipid oxidation and Warner-Bratzler shear force

TBARS was measured using the method reported by Yin *et al*. (1993). For determination of WBSF, the steaks were cooked in a 80 □water bath until core temperature of steaks reached 75 □ and then kept for 20 min. The cooked steaks were stored in a 4 □ refrigerator overnight before testing. From each steak, six or more cores parallel to muscle fiber orientation were removed. Cores were sheared only once using a texture analysis machine (Model TA-XT2i Stable Micro System, England). The average of readings for cores from the same steak was recorded as the WBSF value.

Statistical analysis

Data was reported as mean ± SEM for each experiment. ANOVA tests were performed to identify differences among means, using Statistical Package for the Social Science (SPSS Inc., version 13.0). Statistical significance was declared at P <0.05.

RESULTS AND DISCUSSION

pH value, instrumental color, cooking loss and myoglobin oxidation. The results of pH and myoglobin oxidation indicated that injection of plant extracts did not influence pH and myoglobin oxidation in yak chunks (P>0.05) (data not showed), whatever the composition of injection solutions were. Similarly, injection of any plant extracts did not produce an effect on L*, a*, and b* value of yak meat (P>0.05), which suggests that injection of any plant extracts may not affect the consumers' purchase decisions, since meat color is the most critical factor influencing purchase decisions at the point-of-sale directly. The present study also suggests that no matter what the composition of the mixture of ginger extract and kiwi extract were, the cooking loss of yak meat would not be under influence (P>0.05).

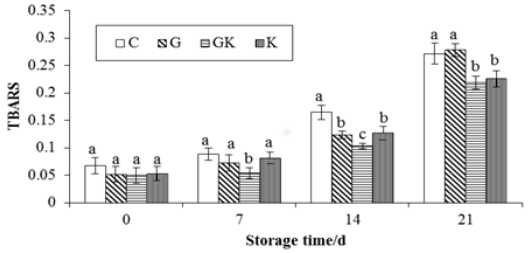

Figure 1. TBARS of yak *longissimus dorsi* muscle during the storage time in the first stage. C: distilled water; G: 0.28% GE; GK: 0.14% GE + 2.3%KE; K: 4.6% KE

TBARS and WBSF. As shown in Figure 1, the TBARS values of mixture of GE and KE-treated yak meat were significantly lower than that of control group (P<0.05) on day 7, 14 and 21. When compared with control, the TBARS values of ginger group only showed a significant difference on day 14, indicating that low concentration of ginger extract cannot inhibit lipid oxidation effectively. Kiwi group showed a significant lower values on day 14 and 21 when compared with control (P<0.05), and mixture of GE and KE-treated group exhibited relatively lower TBARS values than kiwi group on day 7 and 14, suggesting the mixture of GE and KE could inhibit lipid oxidation more effectively. Accordingly, there was a synergistic mechanism

of ginger and kiwifruit extracts existing for tendering yak meat.

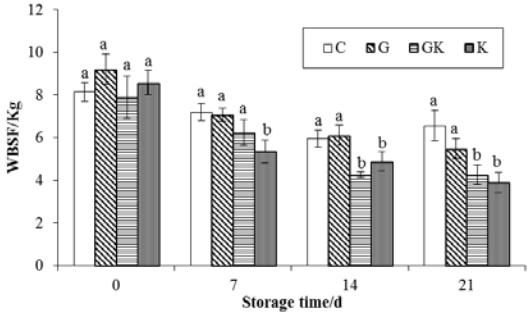

Figure 2. WBSF of yak *longissimus dorsi* muscle during the storage time in the first stage. C: distilled water; G: 0.28% GE; GK: 0.14% GE + 2.3% KE, K: 4.6% KE

Figure 2 showed that WBSF values of mixture group were significantly lower than control on day 7, 14 and 21 (P<0.05). The WBSF values of ginger group at low GE concentration were not significantly different from control. On the other hand, the mixture group had the similar tenderness to kiwi group, suggesting that mixture of GE and KE could tenderize yak meat more effectively even at relatively lower concentration.

Figure 3 showed that TBARS of any plant-extract-treated chunks were significantly lower than that of control on day 7, 14 and 21 (P<0.05), indicating both ginger and kiwi could inhibit lipid oxidation in yak meat effectively. Medium and high concentration groups were significantly different from low concentration group on day 14 and 21 (P<0.05), indicating plant extracts used in this study had a dose effect till the concentration of 0.18% GE + 0.13% KE, which should be the optimal concentration to inhibit lipid oxidation in yak meat.

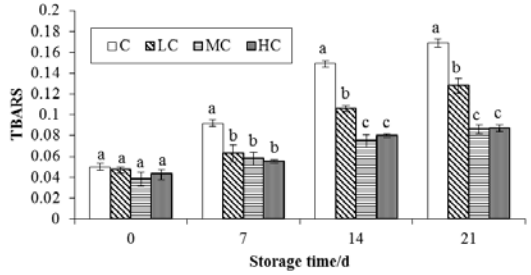

Figure 3. TBARS of yak *longissimus dorsi* muscle during the storage time in the second stage. C: distilled water; LC: 0.091% GE + 0.13% KE; MC: 0.18% GE + 0.13% KE; HC: 0.23% GE + 0.26% KE

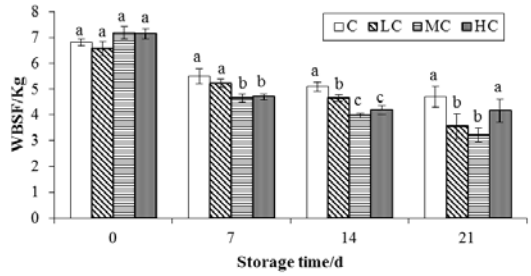

Figure 4. WBSF of yak *longissimus dorsi* muscle during the storage time in the second stage. C: distilled water; LC: 0.091% GE + 0.13% KE; MC: 0.18% GE + 0.13% KE; HC: 0.23% GE + 0.26% KE

As showed in Figure 4, the WBSF values of medium and high concentration groups were significantly lower than control on day 7, 14 and 21 ($P<0.05$). Therefore, these two concentrations of plant extract could decrease WBSF values and improve yak meat tenderness effectively. Impressively, medium concentration group had the lowest WBSF value starting from day 7, therefore the medium concentration (0.18% GE + 0.13% KE) was the optimal one for improving the tenderness of yak *longissimus dorsi*.

- CONCLUSION

Our study suggests that there can be a synergistic effect of ginger and kiwi extract toward the tenderization of yak meat. Furthermore, the present study also proposed the optimal of plant extract used to reduce the toughness of yak meat.

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