



Original article

Effects of age on slaughter performance and meat quality of Binlangjang male buffalo

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ABSTRACT

Twelve representative buffalo were selected from 22 suckling calves, 41 weaned calves, 57 reserve bulls and 20 adult bulls for slaughter. The study aims to assess the effect of age on dressing percentage, meat percentage and carcass meat yield and physico-chemical properties of longissimus dorsi and biceps femoris, and to evaluate the correlation between live weight and marbling, backfat thickness, rib eye area. The results showed that the slaughter performance and meat quality of Binlangjang male buffalo showed an obvious change with age. The dressing percentage decreased from 54.93% to 51.22% with the increase of age, while meat percentage and carcass meat yield increased gradually with age, which were 34.58–38.59%, 62.95–75.34%; Marbling, backfat thickness and rib eye area increased with age, and there was significant difference between the situation before 3 months and after 12 months of age ($P < 0.05$). The moisture content was maximum at birth, which then gradually decreased, but the difference was insignificant ($P > 0.05$). The levels of fat, protein, cholesterol and inosine acid were significantly different before 3 months of age from those after 12 months ($P < 0.05$). Cholesterol content was negatively correlated with age, the minimum was 80.25 mg/100 g; Inosine acid content increased with age, reaching 133.11 mg/100 g. Marbling, backfat thickness, rib eye area had a high correlation with live weight, with correlation coefficients respectively at 0.9096, 0.9291, 0.9551. Based on the prediction model of live weight, Buffaloes was suitable for slaughtering for superior slaughter performance and meat quality after 24 months of age.

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1. Introduction

Traditionally, consumers and culturists regard as rough, poor taste, smell of mutton of buffalo meat and low slaughter performance. The slaughtered buffalos are basically obsolete cows or 10-year-old bulls without fattening, leading to consumers' cognitive error in buffalo meat quality and slaughter performance. Studies found that buffalo meat at the appropriate age of slaughter is

more tender and fresh than beef, rich in high protein, high essential amino acids, with low intramuscular fat, low saturated fatty acids, low cholesterol and triglycerides, plus ω -6 and ω -3 closely related to human health (Neath et al., 2007; Iqbal et al., 2007; Uriyapongson, 2013; Arganosa, 1973; Ross, 1975; Joksimovic and Oqnjanovic, 1977; Baruah et al., 1990; Anjaneyulu et al., 1990, 1994; Bhat and Lakshmanan, 1998; Sharma, 1999; Kondaiah, 2002; Di et al., 2003; Manafiazar et al., 2007; Rosalina et al., 2007, 2008; Rao et al., 2009; Choi and Kim, 2009; Kandeepan et al., 2009; Nurainia et al., 2013; Qiu, 1985; Wu et al., 2010; Yang, 2011; Yin et al., 2013; Tao et al., 2014). Kandeepan et al. reported that average dressing percentage of buffalo was 55.40–59.00% (Kandeepan et al., 2009) in modern farming mode, with breeding cost lower than that of other buffalo. Age is an important factor affecting meat quality (Tang, 2010; Daya and Pant, 2017; Sharma et al., 2017). Borghese studied meat quality of Mediterranean Italian buffalo at 20, 28, and 36 weeks of age, and found that the meat organoleptic quality and physico-chemical scores

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were higher after those at 36 weeks of age; Kashif also examined physiochemical and organoleptic quality of longissimus dorsi of buffaloes aged 1.5 years, 1.5–2 years, and over 2 years which were randomly sampled from the local meat market in Pakistan, regarding that quality of buffalo over 2 years old was better (Borghese et al., 1978; Awan et al., 2014; Herrera-France et al., 2017). Therefore, buffalo can be developed into a high-quality meat resource (see Table 1).

As the only river buffalo in China, Binlangjiang buffaloes are mainly distributed in the southwest of China. Cows are used for milk production, while the bulls can gradually develop for table purpose to solve the current issue of high price and short supply of beef. At present, the study on slaughter performance and meat quality of Binlangjiang male buffalo of different ages is limited or incomplete. In this study, continuous slaughter method and laboratory analysis were adopted in systematic, in-depth research of meat performance and meat quality of Binlangjiang male buffalo of different ages. The purpose is to evaluate the effects of age on dressing percentage, meat percentage and carcass meat yield and physico-chemical properties of longissimus dorsi and biceps femoris, and to evaluate the correlation between live weight and marbling, backfat thickness, rib eye area. Appropriate slaughtering age will be determined to provide the basis for giving play to meat value of Binlangjiang male buffalo, which plays an important role in improving economic efficiency (see Table 2).

Binlangjiang buffaloes are the only river buffaloes in China identified by the Chinese Commission on Animal Genetic Resources in 2008. Having been raised in Tengchong County in the upper reaches of Binlangjiang in western Yunnan for over 500 years, the cows are used for milk production (Miao et al., 2008), while the bulls are used for meat production after fattening (see Table 3).

The 12 buffalo in good body condition and representative of the group were randomly selected for continuous slaughter test from 63 male calves (22 suckling male calves and 41 weaned male calves), 57 reserve bulls and 20 adult bulls in the Bafule Binlangjiang buffalo core field of Tengchong. The buffalo were 53.57 ± 19.22 kg (5, 36, 66 days), 109.7 ± 32.05 kg (144, 154, 179 days), 232.5 ± 29.65 kg (373, 547 days) and 390.17 ± 78.49 kg (735, 969, 1114 days) in weight and age, each group with 3 buffalo. The dressing percentage, meat percentage and carcass meat yield and the physical properties and chemical compositions of longissimus dorsi and biceps femoris were measured.

The test buffalo after weighing and 24 h of water and food fasting were placed in a clean plastic sheeting, with the head and hind legs fixed with a rope, to be rinsed with water before electric shock. Bovine jugular vein blood after quiet. Blood was collected and weighed. Then the skin was peeled off, with genitals, head, hoof, tail and internal organs removed and weighed. The digestive system was removed from the abdominal cavity and weighed, and further weighed after the contents were removed. At the same time, two samples of biceps femoris and longissimus dorsi (between 12 and 13th rib) on the left side of the carcass were taken. For one of them, backfat thickness and rib eye area of longissimus dorsi (between 12 and 13th rib), pH, marbling score, water holding capacity, flesh color and muscle fiber diameter were measured on the spot. The other was frozen at –20 °C and taken to the laboratory for the determination of the shear force and chemical composition.

The rib eye area was determined by graph paper. Marbling score evaluation was conducted based on the American NPPC standard reference map. Longissimus dorsi pH was measured by LEICHI BJ-260, pH meter at 45 min after the slaughter. Flesh color was measured by DY-300 portable colorimeter, while shear force was measured by NY/T1180-2006TAPlus texture analyzer, moisture was determined by drying under ambient pressure, the result was necessary to reach constant weight. Then, samples were

ground using a blender and dry ice to obtain a homogenous powder (AOAC, 1990). Ether extract was obtained by diethyl ether extraction in Soxhlet extractor. Crude protein content was determined using the Kjeldahl apparatus, and protein was computed using a fixed conversion factor of 6.25 g of protein/g of N. Ash content was determined by incineration (550 ± 20 °C) in a muffle furnace. Inosinic acid and cholesterol were determined by HPLC with external standard method.

2. Statistical analysis and model selection

The test data were analyzed by EXCEL and SPSS19.0 software. The multiple regression analysis was used to estimate slaughtering traits of Binlangjiang male buffalo, with related prediction models obtained.

3. Results and discussion

3.1. The change law in slaughter performance of Binlangjiang buffalo at different ages

Dressing percentage, meat percentage and carcass meat yield are important indicators for judging the slaughter performance. Dressing percentage decreases with age, ranging from 48.73% to 54.93%, with that of adult bulls six percentage points lower than that of suckling calves, which is consistent with reports by Manafiazar et al. (2007), Rosalina et al. (2007, 2008) and Kandeepan et al. (2009). Dressing percentage is closely related to variety, age, feeding levels and feeding management. Kandeepan et al. reported a 55.50% dressing percentage for the Mediterranean buffalo, 53.00% for the Australian buffalo and 43.00–57.00% for the obsolete old buffalo. The average dressing percentage in the modern farming mode is 55.40–59.00% (Kandeepan et al., 2009; Arshadullah et al., 2017). At the same age, dressing percentage of Binlangjiang buffalo is 3.77% lower than that of buffalo, which is like that of gayals (Qiu et al., 1995; Fan, 2005). The low dressing percentage of buffalo is closely related to its big proportion of non-edible parts (Manafiazar et al., 2007; Rosalina et al., 2007, 2008).

The net meat and meat yield rate of carcass increased with age, respectively in the range of 34.58–38.59%, 62.95–75.34%. Meat yield rate of carcass varies with the dressing percentage which changes with carcass composition in consistency with reports by Joksimovic et al., Bhat et al., and Sharma. For buffaloes with dressing percentage at 43–44%, meat yield rate is 65–70%; while at 51.4%, the net meat rate is 66.8% (Joksimovic and Oqjanovic, 1977; Bhat and Lakshmanan, 1998; Sharma, 1999; Ong et al., 2017). The meat-bone ratio increased with age, falling in the range of 1.93–2.94.

3.2. The change law in meat features of Binlangjiang buffalo at different ages

3.2.1. Comparison of muscle physiological characteristics of Binlangjiang male buffaloes at different ages

Marbling, backfat thickness, rib eye area, flesh color and muscle fiber are greatly influenced by age, with significant differences demonstrated ($P < .05$). Marbling, backfat thickness and rib eye area increased with age, but marbling tended to be stable after 12 months of age. The backfat did not deposit before 5 months of age, but subcutaneous fat gradually deposited from 6 months of age. Marbling was lower than that of Rosalina et al., which might be because Binlangjiang buffalo is lighter for the same age of buffalo (Rosalina et al., 2007). The rib eye area was consistent with that

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