EFFECT OF SUPPLEMENTED SUCROSE AND INJECTED INSULIN UNDER DIFFERENT RECOVERY TIME ON GLUCOSE, FRUCTOSE AND RIBOSE MEAT LAMB

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Abstract: An experiment was conducted in order to study the influence of supplemented sucrose and injected insulin under different recovery times following transportation on lamb flavor quality. For the purpose the study used fifty four female local lamb (10 to 12 months of age) with weight ranging from 14 to 17 kg. The experimental lamb were assigned into a completely randomized design with 2x3x3 factorial arrangement with 3 replications. The first factor was sucrose supplementation with 2 levels (0 and 6 g/kg body weight). The second factor was insulin injection after transportation with 3 levels (0, 0,3 and 0,6 IU). The third factor was the duration of recovery times with 3 levels (2, 4 and 6 h prior to slaughtering). Parameters measured were glucose, fructose, and ribose. Results showed that feeding sugar and injecting insulin to lamb following transportation increased glucose, fructose, and ribose content of raw meat while recovery time was not affect meat sugar content. Interaction was not occur between treatment of Sugar, insulin, and recovery time.

Keywords: lamb; transportation; sucrose; insulin

1. INTRODUCTION

Animal movement from a farm to an abattoir is an important phase under view point of meat production because it significantly affects meat quality. The movem time and condition of transportation, macroclimate along transportation, lack of feed and water supply, and mingling with other animals. Preslaughtered transportation as a stresssor may also affect meat quality traits in goats by depleting the glycogen content of the meat (Kadim et al. 2006).

Owing to muscle cell metabolic activation after slaughter, and lack of oxygen is tissue, muscle cells shift from axidative phosphorylation to glycolysis for ATP generation (Shen et al. 2006). Poso and Puolanne (2005) also suggested that in the case of lack of oxygen in muscle cells, lactate is formed from pyruvate and transported out of the muscle fibres. According to Hwang et al. (2003), stressors can accelerate glycogen catabolism and consequently cause decline in pH post-mortem. McVeigh & Tarrant (1981) reported that cattle treated with a six-hour mingling stress contained glycogen 41% (418.2 mol glycogen/g wet tissue) lower than glycogen (1003.7 mol/g wet tissue) of unstressed cattle.

Among efforts performed in order to accelerate glycogen recovery was high sugar compound either as feed supplement or drink supplement during marketing animal. Feeding sire (male cattle) with glucose solution (5% w/v) during 18 - 20 hours period of confinement consumed more water (19 L) than sire fed electrolyte solution (12 L) or water (17.4 L). Glucose solution, however, unsatisfied to influence ultimate pH, except for meat color and carcass loss

reduced up to 3% (Schaefer *et al.*, 1990). Shorthose & Wythes (1988) reported feeding 5.4 g sucrose/kg BW at 30 hours preslaughter increased dressing percentage and slaughter weight but it did not affect ultimate pH. Otherwise, Priyodarsono (1990) reported feeding 4 g sugar/kg BW of Bali cattle (Bos sundaicus) did not affect both carcass weight and ultimate pH.

All previous research above repealed feeding sugar would affect body weight, dressing percentage, reduced carcass loss, and developed meat color but did not affect blood glucose and ultimate pH of meat. Likely, muscle cells of ruminant perform slow glucose uptake from circulatory system. Therefore, in order to optimize glucose uptake, feeding sugar must be combined with insulin treatment. It was expected that insulin would increase glucose uptake into muscle cells. Recent research concerned about feeding sugar and insulin to lamb under different recovery times following transportation in order to increase meat glucose. The research aimed to repeal effect of supplementing sugar or injecting insulin to lamb following transportation on meat glucose level

2. METHODS

Research was conducted at abattoir of Faculty of Animal Science, Bogor Agriculture University (IPB). Nonvolatile component was analyzed at Postharvest Laboratory of Center for Postharvest Research, Bogor.

Fifty-four ewe lamb with 14-17 kg of initial BW of 10 - 12 months of age were used in this research. All lambs were obtained from small scale farm at Desa Pasirangin, Megamendung, Bogor. Insulin crystals were obtained from SIGMA (SIGMA 1-5,500), while sugar originated from local sugar contained 97.23% of sucrose and 1.05% of glucose.

The experiment was accomplished under completely randomized design with three factors (2 x 3 x 3) and three replicates. First factor was sugar treatment (no sugar and 6 g sugar/kg BW), second factor was insulin treatment (no insulin, insulin 0.3 IU, and insulin 0.6 IU), and third factor was recovery time (2, 4, and 6 hours).

3. RESULTS AND DISCUSSION

Meat pH was one of indicators used for evaluating meat quality bias. Recent research revealed that lamb meat pH was significantly affected with sugar treatment but not with insulin or recovery time treatment following transportation. Lamb fed 6 g sugar/kg BW resulted in lower meat pH (5.81) than meat pH (6.10) of lamb fed no sugar (Table 1).

Meat pH was determined with glycogen and lactic acid contents of animal meat postmortem. Anaerobe glycolysis would occur during conversion of muscle to meat. In this process, glycogen was degraded into lactic acid in order to generate readily available energy. The glycolysis would occur continuously until reserve of muscle glycogen exhausted or low pH of muscle reached to cease activity of glycolytic enzymes. If glycogen reserve was plentiful lactic acid produced from anaerobe glycolysis would be ample and sufficient to decrease pH value until ultimate pH (5.4-5.6) reached. Lamb fed 6 g sugar/kg BW had more glycogen store and as a result, produced more lactic acid as well (Dewi, 2004). Thus, meat pH became lower (5.81) so that meat pH was in above of isoelectric point and was categorized as normal. On the contrary, lamb fed no sugar had meat pH above 6 and was categorized as DFD.

One of nonvolatile compounds was sub fractions contained reduced sugar. This reduced sugar generated from low molecule carbohydrate such as glucose, fructose, and ribose. This

research showed that meat glucose was significantly affected with sugar or insulin treatment but not with recovery time treatment following transportation. In addition, it was no interaction among the treatment. Lamb meat glucose was significantly affected (P<0.01) with glucose treatment following transportation (Table 2). Lamb fed 6 g sugar/kg BW had higher meat glucose (9.116 mg/g) than lamb fed no sugar (5.955 mg/g). Presumably, lamb fed 6 g sugar/kg BW produced more propionate in it rumen than lamb fed no sugar. Propionic acid was absorbed from rumen into blood circulatory and carried to liver. Hepatocyte cells of liver converted propionic acid into glucose ((Lehninger, 1982; Parrakasi, 1995).

Likewise, lamb meat glucose was significantly affected (P<0.01) with insulin treatment. Glucose meat of lamb injected with insulin 0.6 IU/kg BW showed higher value (8.808 mg/g),than glucose meat of lamb injected with insulin 0.3 IU/kg BW (7.434 mg/g) or insulin 0 IU/kg BW (6.364 mg/g). According to Turner & Bagnara (1976), insulin treatment would accelerate uptake post absorptive glucose from liver through blood circulatory into muscle tissues. Fructose level of lamb fed 6 g sugar/kg BW differed significantly (P<0.01) from lamb fed no sugar (Table 3). Similarly, fructose level of lamb injected with insulin 6 IU/kg BW differed significantly (P<0.01) from lamb injected with insulin 0 or 0.3 IU/kg BW although between insulin 0 and 0.3 IU/kg BW itself showed no significant different in fructose level. Else, recovery time did not affect to fructose level and no interaction occurred among treatment.

Lamb meat ribose was significantly affected with sugar treatment (P<0.01) or insulin treatment (P<0.01) but not with recovery time. Moreover, no interaction occurred among treatment and also no significant effect occurred between insulin 0 and 0.3 IU/kg BW in ribose level (Table 4). Sucrose was a main soluble carbohydrate so it was digested and metabolized quickly and could be utilized completely. In the rumen, sucrose was degraded with microbial sucrase into fructose and glucose. Then, the fructose and glucose were converted into piruvic acid through glycolytic pathway. Afterward, piruvic acid was converted into volatil fatty acids (VFAs), ie. Acetate, propionate, and butryrate. Propionate was absorbed from rumen to blood circulatory (hepatic portal vein) and was carried to liver (Tilman *et al.*, 1982; Lehningher 1994; Parrakasi 1995). In liver tissue, propionate would converted into glucose and then would be stored as a muscle glucose reserve where the glucose was metabolized quickly to generate energy or was stored as muscle glycogen (Aberle & Forrest, 2001).

Sugar (6 g/kg BW) was fed in solution form and forcedly drunk to lamb. Lamb with 17 kg of BW consumed 102 g glucose/head. This treatment did not consider amount of sugar actually undegraded in the rumen and sugar allocated to produce propionate or other VFAs that might be less than 102 g. Otherwise, average of sugar consumed in this research more than amount of sucrose consumed with cattle (5.4 g/kg BW) reported with Shorthose and Wythes (1988). Meanwhile, Schafer et al. (1991) fed 5% glucose solution to cattle during 18-20 hour confinement period following 6 hours transportation with total consumption was 18 L/head or almost 1 kg glucose/head (1.66 g/kg BW). Moreover, Schafer *et al.* (1991) claimed that preslaughter glucose treatment could be effective in improving meat quality if glucose was consumed in appropriate amount.

Meat carbohydrate was significantly affected with insulin treatment. Insulin would accelerate glucose uptake with muscle (Turner and Bagnara 1976). Thus, lamb injected with insulin would utilize more postabsortive glucose and liver glucose into muscle tissue. Feeding glucose or injecting insulin would quickly replace glycogen or glucose expense during transportation resulted in meat carbohydrate (glucose, fructose, ribose) maintained in a high level. Dewi (2004) reported glycogen and lactic acid concentration in meat of lamb fed sugar or insulin were higher than those of lamb fed no sugar or insulin. High glycogen would produce high lactic acid and in turn, able to decrease pH until normal ultimate pH could be

reached. Meat of lamb fed sugar had lower pH and higher carbohydrate than the meat of lamb fed no sugar. This result was consistent to result of Roman's et al. (1985) who was reported that cattle meat with low pH contained more reduced sugar than cattle meat with high pH.

4. CONCLUSION

Feeding sugar and injecting insulin to lamb following transportation increased glucose, fructose, and ribose content of raw meat while recovery time was not affect meat sugar content. Interaction was not occur between treatment of Sugar, insulin, and recovery time.

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