# STUDIES ON NUTRIONALLY-RELATED BLOOD METABOLITES – TOTAL PROTEIN AND GLUCOSE LEVELS, IN GOATS OF KINTA AND HILIR PERAK DISTRICTS

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**ABSTRACT.** The objective of this study was to examine the nutritionally-related blood metabolites; total protein and glucose levels in goats of Kinta and Hilir Perak districts. A total of eight farms were screened, involving a total of 220 animals. Serum samples were collected in plain tubes for total protein determination, while plasma samples were collected in sodium fluoride tubes for glucose determination. Total protein and glucose determination were carried out using Idexx Vettest 8008 Blood Chemistry Analyzer. Results show that goats in seven out of eight farms had malnutrition problems and poor body scores. Farmers were given advices based on the laboratory results obtained from this study.

*Keyword:* goats, plasma samples, total protein, glucose level, body score, malnutrition

## INTRODUCTION

The small ruminant population in Malaysia has been steadily increasing (Livestock Statistics, Department of Veterinary services, 2009). In 2008, the total population of goats in Malaysia was 477,480 heads which was an increment of 49,217 from the previous year 2007 (Livestock Statistics, Department of Veterinary Services, 2009). There has been concerted efforts by the government to encourage small ruminant farming among smallholders as it can be a lucrative venture aimed to promote Malaysia as the global centre for halal products and to make the agriculture sector as the third pillar of economic growth.

Feed is the main production cost in a livestock operation (Haenlein, 2001). It is important to make sure the animals diet is formulated to support optimal production and be economical so that it does not burden the poor farmers. It is important to accurately assess the nutritional status of goats as such information is fundamental for the formulation of their diets. The conventional methods of using changes in live-weight and body condition scores (Ndlovu *et al*., 2007) to determine the nutritional status of livestock lacks

accuracy (Schroder and Staufenbiel, 2006). Knowledge of the metabolic profiles could be useful in predicting and avoiding metabolic problems before a serious or even irreparable condition is presented (Caldeira *et al*., 2007 and Kida *et al*., 2007).

Analysis of biochemical properties such as glucose, total protein, blood urea nitrogen, creatinine and cholesterol is essential in diagnosing the various nutritional, pathological and metabolic disorders (Daramola *et al*., 2005) in goats. A good diet will prevent nutrition related disorders, thus promoting health and productivity. Malnutrition is one of the causes of morbidity and mortality, reducing productivity and incurring losses for farmers.

Due to the unique nature of the goats gastrointestinal tract, feed such as forage becomes the major component of the ruminants diet. Nutrient requirements are influenced by few factors; age, stage of production, forage quality and quantity, production system (range versus confinement), environmental or climatic conditions, management and body condition (Lema). Nutrients can be divided into macronutrient (major nutrients) and micronutrients. Generally a nutrient should include water, energy, protein, mineral, and vitamins (Lema, Susan). The need for water is basic in these small ruminants. An unlimited, fresh water supply is needed for goats in all stages of production. Limitations to water intake may limit feed intake and hampering production (Lema).

When formulating goats mineral supplement the relationship of minerals to each other must be taken into account. The amount of one mineral may influence the amount of another mineral needed in the diet (Berger, 2005). Lack of a mineral creates a deficiency, while too much may cause toxicity. Goats require dietary sources of the fat-soluble vitamins A, D, and E. Other than that, niacin and thiamin B-vitamin are also beneficial for the goats (Lema).

The blood sugar level in livestock is maintained at a constant range through the action of several hormones mainly insulin and glucagon (Scott, 1999; Singh, 2004 and Randox, 2006). Very low levels of glucose in the blood is typified in livestock by gross reduction in weight gain, milk yield and alteration in the fatty acid composition of the milk (Scott, 1999; Zubcic, 2001; Lazzaro, 2006 and Tambuwal *et al*., 2002)

Total protein measurements can reflect nutritional status and may be used to screen for and help diagnose kidney disease, liver disease, and many other conditions (Sahlu *et al.,* 1992). Low total protein levels may suggest a liver disorder, kidney disorder, or a disorder in which protein is not digested or absorbed properly. Low levels may be seen in severe malnutrition and with conditions that cause malabsorption. High total protein levels may be seen with chronic inflammation or infections (Sahlu *et al.,* 1992).

One of the best and easiest way to measure nutritional status and potential

reproductive performances of the goats is by determining the body score.

## MATERIALS AND METHOD

A single visit to eight small ruminant farms were carried out, four each in Kinta and Hilir Perak Districts. The farms were coded as in Table 2. Two hundred and twenty animals were randomly selected for the study. Body condition scores were assigned on a scale of 1 to 5, according to Friedricks (1993), with a score of 1 indicating a thin and emaciated goat whilst a condition of 5 indicating an obese goat. Blood samples were taken via jugular vein into a plain test tube for total protein determination and one containing sodium fluoride (antiglycolytic agent which inhibits the glycolysis process) for glucose determination.

Plain test tubes containing blood for total protein assay were centrifuged at 1,000G for 10 minutes to obtain serum, which was stored at -20°C if test was not carried out immediately. Total protein and glucose determination were carried out using Idexx Vettest 8008 Blood Chemistry Analyzer (http://www.IDEXX.com), which uses dry-slide technology. However for farm BG01 and PR04, glucose determination could not be carried out due to insufficient dry slides for the parameter. Total protein and glucose value among the tested animals were compared to the reference value as suggested in Table 1. Details of the types of breed, animal population, management system and total number of samples taken from randomly selected animals for the biochemical assay are listed as in Table 2. Seven farms practised semi-intensive management, where the animals were allowed to graze during the day for 4 to 8 hours and housed in a raised floor wooden sheds at night. One farm practised intensive management where the animals were housed permanently and practised zero grazing.

Most of the farmers fed their animal with grass namely napier and guinea. Goat pellet were also provided in their feed. These goats were also given supplements like mineral blocks, multivitamin and salt as shown in Table 3.

### Data analysis

Data were statistically analysed by SPSS version 12.0 for windows (SPSS Inc., Chicago, IL.). Before analysis proceeded, data were evaluated for their normal distribution. Normality of data was checked either by Kolmogorov-Smirnov

**Table 1.** Reference values of selected blood chemistry measurements in clinically healthy goats

| Blood parameter | Reference values |
|---|---|
| Total protein (g/L) | 64 – 78 |
| Glucose (mmol/L) | 3.0 – 5.7 |

Source : http://www.IDEXX.com

**Table 2.** Types of breed, management system, animal population and total number of samples for determination of total protein and glucose level.

| District | Farm Code | Type of breed | Farm Management | Farm animal population | No. of samples taken from randomly selected animal |
|---|---|---|---|---|---|
| Kinta | BG01 | Saenan, boer, jamnapari and katjang | Semi-Intensive | 108 | 29 |
| | GP01 | Katjang, boer, jamnapari and anglo-nubian | Semi-Intensive | 87 | 19 |
| | GP02 | Saenan, boer and jamnapari | Semi-Intensive | 100 | 31 |
| | GP03 | Mix breed | Semi-Intensive | 121 | 22 |
| Hilir Perak | PR01 | Saenan, boer, cross jamnapari | Intensive | 31 | 27 |
| | PR02 | Boer and katjang | Semi-Intensive | 80 | 21 |
| | PR03 | Jamnapari cross breed, katjang cross breed | Semi-Intensive | 92 | 45 |
| | PR04 | Boer | Semi-Intensive | 72 | 26 |

**Table 3.** Types of feed and supplements given to the animals.

| Farm Code | Supplements | Types of feed |
|---|---|---|
| BG01 | Mineral blocks & vitamin B complex | Napier grass (cut & carry), corn, rice husk/ bran |
| GP01 | Mineral blocks & vitamin B complex | Napier and guinea grass (cut & carry and also graze), pellet |
| GP02 | Salt, mineral blocks, molasses, Vitamin B12, iron and multivitamin | Napier Taiwan grass (cut & carry and also graze), pellet and occasionally PKC mix with grass |
| GP03 | Salt and mineral blocks | Grass (cut & carry), goat pellet |
| PR01 | Nil | Napier grass (cut & carry), pellet – starter, grower |
| PR02 | Salt, mineral blocks & vitamins | Grass (graze) and oil palm front (OPF) |
| PR03 | Mineral blocks & molasses | Grass (graze) and goat pellet |
| PR04 | Salt and urea molasses block | Grass (graze)and goat pellet |

test of normality, detrended Q-Q plot or skewness value. The frequencies of goats that had total protein and glucose levels at below normal, normal and above normal than that of the reference value were statistically analysed by chi-square test. Value of $p<0.05$ was considered to be significant.

## RESULTS AND DISCUSSION

A close inspection of Table 4 revealed that 64% of the animals tested had normal

**Table 4.** Proportion of goats with total protein level at below normal, normal and above normal values from randomly selected animals of eight farms in Kinta and Hilir Perak Districts (N = 220)

| No. | Farm code | No. of samples, n | No. of samples with total protein level compared to reference value, n (%) | | | p-value | Body Score level Range: 1 – 5 |
|---|---|---|---|---|---|---|---|
| | | | Below | Normal | Above | | |
| 1 | BG01 | 29 | 3 (10) | 21 (72) | 5 (17) | <0.001 | 2.0 – 2.5 |
| 2 | GP01 | 19 | 4 (21) | 12 (63) | 3 (16) | 0.021 | 1.5 – 2.0 |
| 3 | GP02 | 22 | 8 (36) | 11 (50) | 3 (14) | 0.108 | 3.0 - 3.5 |
| 4 | PR01 | 31 | 7 (23) | 21 (68) | 3 (10) | <0.001 | 70% with 1.5 – 2.0 |
| 5 | PR02 | 21 | 2 (10) | 14 (67) | 5 (24) | 0.004 | 1.5 – 2.0 |
| 6 | PR03 | 45 | 12 (27) | 21 (47) | 12 (27) | 0.165 | 1.0 (Skinny animal) |
| 7 | PR04 | 26 | 0 | 19 (73) | 7 (27) | 0.019 | 1.0 (Skinny animal) |
| 8 | GP03 | 27 | 5 (19) | 22 (81) | 0 | 0.001 | 1.0 (Skinny animal) |
| | Total | 220 | 41 (19) | 141 (64) | 38 (17) | <0.001 | |

Values in parentheses indicates percentage of goats, $p<0.05$ indicates significant

range of total serum protein. The trend was also true for the animals in the farm BG01, GP01, PR01, PR02, PR04 and GP03. In each farm mentioned earlier, the frequency of animals with protein levels that fell into category below normal, normal and above normal the reference value were significantly different ($p<0.05$). Farm GP02 and PR03 showed similar proportion of the protein levels among the animals ($p = 0.108$ and 0.165 respectively). The results suggested that the animals were provided with enough protein nutrient. Farm PR04 has 73% of its animals with normal range of total protein. Animals in this farm were fed with supplements urea molases.

Mature animal use effectively the naturally occurring protein and nonprotein

**Table 5.** Percentage of protein suggested for ruminants diet

| Production Phase | Growth Potential | |
|---|---|---|
| | Rapid | Moderate |
| Birth to weaning | 21% protein creep | 21% protein creep |
| Weaning to 60 lb | 18% protein | |
| Weaning to 45 lb | | 18% protein |
| 60 – 85 lb | 15% protein | |
| 45 – 85 lb | | 15% protein |
| 85 lb to market weight | 12.5% protein | 12.5% protein |
| Provide unlimited supply of clean, fresh water and mineral supplementation as desired. | | |

Source: Lema (2010)

nitrogen (urea) in their diets (Lema, M., 2010). Common sources of natural protein supplements include cottonseed, soybean, sunflower, linseed, and peanut meals. These oilseed meals contain 40-50% protein, which are excellent sources of supplemental protein. Grains, however, are low in protein with only around 8-11%. Additional protein is necessary for the maximum performance of breeding animals and those in production.

As explained earlier, glucose determination could not be carried out in farm BG01 and PR04 due to insufficient dry slides for that parameter. Hence, a smaller sample size was reported for the glucose test (165) compared to the protein test (222) (Tables 4 and 6). Contrary to results for protein levels, most of the animals tested (58% out of 165 samples) had glucose levels below than that of the reference value (Table 6). The trend was also true for animals in the farm GP01, PR03 and GP03. In each farm mentioned earlier, the frequency of animals with glucose levels that fell into categories below normal, normal and above normal, the reference value were significantly different ($p<0.05$). Only one farm (PR02) showed similar proportion of the glucose levels among the animals ($p = 0.127$). The two farms (GP02 and PR01) had provided the animals with sufficient forage and concentrates resulting in normal glucose levels with no incidence of low glucose levels (below the reference value).

Glucose is needed for adequate function of cells. In farm GP02 for example, the farmer gave good sources of nutrients for his animals such as napier, PKC, salt, molasses and multivitamins, vitamin $B_{12}$ and iron. Therefore the animals had good body scores.

Due to lack of carbohydrate, most of the animals are skinny and lacked energy. When glucose in the body is not enough, protein and fat layer (cholesterol) undergoes breakdown to convert to glucose to give energy for the animal. This can be seen in the farm PR03.

Most of the animal studied in these farms have low body score levels between 1.5 to 2 (70%, as illustrated in Tables 4 and 6). Animal in farm GP02 had good body score level of 3 to 3.5. Body condition scoring is one of the best and easiest way to be used as a measuring tool to check the nutritional status and potential reproductive performance of the goat. They are scored manually by determining the degree of muscling and fat covering around and over the vertebrae in the loin area. Scores ranging from 0 (extremely thin) to 5 (extremely fat) Friedricks (1993).

If forage provided is of poor quality, these goats should be supplemented with a high-protein feed supplements. Water provided daily to the goats must be wholesome and hygienic without faecal contamination. Macro and micro mineral in the water need to be ensured at the balance level.

**Table 6.** Proportion of goats with total glucose level at below normal, normal and above normal values from randomly selected animals of eight farms in Kinta and Hilir Perak Districts (N = 165)

| No. | Farm code | No. of samples, n | No. of samples with total glucose level compared to reference value, n (%) | | | p-value | Body Score level Range: 1 – 5 |
|---|---|---|---|---|---|---|---|
| | | | Below | Normal | Above | | |
| 1 | BG01 | - | - | - | - | - | - |
| 2 | GP01 | 19 | 17 (89) | 2 (11) | 0 | 0.001 | 1.5 – 2.0 |
| 3 | GP02 | 22 | 0 | 19 (86) | 3 (14) | 0.001 | 3.0 – 3.5 |
| 4 | PR01 | 31 | 0 | 28 (90) | 3 (10) | <0.001 | 70% with 1.5 – 2.0 |
| 5 | PR02 | 21 | 14 (67) | 7 (33) | 0 | 0.127 | 1.5 – 2.0 |
| 6 | PR03 | 45 | 44 (98) | 1 (2) | 0 | <0.001 | 1.0 (Skinny animal) |
| 7 | PR04 | - | - | - | - | - | - |
| 8 | GP03 | 27 | 20 (74) | 7 (26) | 0 | 0.012 | 1.0 (Skinny animal) |
| | Total | 165 | 95 (58) | 64 (39) | 6 (4) | | |

- Not applicable; Values in parentheses indicates percentage of goats; $p<0.05$ indicates significant

## CONCLUSION

Farmers should provide the right proportion of nutrients to support optimal growth and production of the animals. Besides a well balanced diet will prevent nutritional disorders, thus promoting health and productivity.

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