

**SUPPLEMENTATION OF WET BREWER'S SPENT GRAIN ON  
THE PERFORMANCE OF SALEM BLACK GOATS**

**V. THAVASIAPPAN,**  
**I.D. No. DPV (N) 12008 (VPY)**

Thesis submitted in partial fulfilment of the  
requirements for the degree of

**DOCTOR OF PHILOSOPHY**  
in  
**VETERINARY PHYSIOLOGY**

**DEPARTMENT OF VETERINARY PHYSIOLOGY**  
**VETERINARY COLLEGE AND RESEARCH INSTITUTE**  
**NAMAKKAL - 637 002**

**TAMIL NADU VETERINARY AND ANIMAL SCIENCES UNIVERSITY**  
**CHENNAI - 600 051**

**2016**

TAMIL NADU VETERINARY AND ANIMAL SCIENCES UNIVERSITY

CERTIFICATE

This is to certify that the thesis entitled "SUPPLEMENTATION OF WET  
BREWER'S SPENT GRAIN ON THE PERFORMANCE OF SALEM BLACK  
GOATS" submitted in partial fulfillment of the requirements for the degree of  
DOCTOR OF PHILOSOPHY in VETERINARY PHYSIOLOGY to the  
TAMIL NADU VETERINARY AND ANIMAL SCIENCES UNIVERSITY, Chennai  
is a record of bonafide research work carried out by V. THAVASIAPPAN  
I.D.No. DPV (N) 12008 (VPY) under my supervision and guidance and that no  
part of this thesis has been submitted for the award of any other degree, diploma,  
fellowship or other similar titles or prizes.

Date: 04-08-2016

Place: Namakkal

Approved:

CHAIRMAN:

MEMBERS:

  
(K. NANJAPPAN)  
(Chairman)

  
(K. NANJAPPAN)

1. (K.A. DORAISAMY)

2. (R.EZAKIAL NAPOLEAN)

3. (P.VISHA)

Date : 6/10/2016

Place : Namakkal



External Examiner

  
B. SWATHI

Assoc. Prof & Head  
Dept. of Physiology  
C.V.Sc, Rajendranagar  
Telangana

## ABSTRACT

**Title** : **SUPPLEMENTATION OF WET BREWER'S SPENT GRAIN ON THE PERFORMANCE OF SALEM BLACK GOATS**

**Name** : **V.THAVASIAPPAN**

**Degree to which submitted** : **Ph.D (Veterinary Physiology)**

**Chairman** : **Dr.K.Nanjappan**

**Department** : **VETERINARY PHYSIOLOGY**

**College** : **Veterinary College and Research Institute,  
Namakkal - 637 002**

**University** : **Tamil Nadu Veterinary and Animal Sciences  
University, Chennai - 51**

**Year** : **2016**

Wet brewer's spent grain (WBSG) is the extracted residue remaining after grains have been fermented during beer making process. The annual WBSG production in India is approximately 0.4 million tones and can serve as a good feed ingredient for livestock especially for ruminants as it is a good source of protein with a crude protein content ranging from 25 to 34 per cent and has 7 to 10 per cent crude fat.

However, effective utilization of wet brewer's spent grain available in India by replacing concentrate feed in the diets of goats has not been exhaustively studied and documented. Hence, the present study was proposed to evaluate the effect of inclusion of wet brewer's spent grain replacing the concentrate feed on the growth and reproductive performance of Salem Black breed of goats.

Proximate composition of WBSG viz. crude protein, crude fibre, ether extract, total ash and nitrogen free extractives were estimated on DM basis. The results indicated that the WBSG is good source of dietary protein having 27.47 per cent crude protein.

The fatty acids profile of wet brewer's spent grain was found to contain MUFA and PUFA with a PUFA: SFA ratio of 1.97.

*In vitro* dry matter and nitrogen degradability of wet brewer's spent grain were determined using a modified rumen simulation technique (TANUVAS-RUSITEC™). The effective DM and nitrogen degradability of WBSG were 40.72 and 33.40 per cent, respectively. The rumen degradable protein (RDP) was 32.72 per cent and rumen undegradable protein (RUP) was 54.93 per cent.

Twenty-four numbers of Salem Black does aged between 8 and 10 months were randomly distributed into four treatment groups of six animals each. The T1 group was fed with only roughage without concentrate feed, the T2 group was fed with roughage supplemented with concentrate feed, the T3 group with roughage along with wet brewer's spent grain by replacing concentrate at 50 per cent level and the T4 group was fed with roughage along with wet brewer's spent grain replacing concentrate at 100 per cent with isonitrogenous and isocaloric level.

Monthly body weight of adult does and feed consumption were recorded. Growth performance and body weight gain were calculated.

The DMI of Salem Black does was significantly ( $p < 0.05$ ) lower when fed with 100 per cent WBSG than the concentrate during non pregnant and pregráant stages.

The body weight was significantly ( $p < 0.05$ ) higher from the beginning of the trial, throughout gestation and lactation in the 100 per cent WBSG supplemented group compared to other groups.

The reproductive traits and reproductive performance like conception rate, gestation length and birth weight of kids etc., were studied in all the groups.

The conception rate after first insemination and subsequent mating was 100 per cent in all the treatment groups. The gestation length did not vary between the treatment groups. The kids born to the does supplemented with 100 per cent WBSG had significantly ( $p < 0.05$ ) higher birth weight and weaning weight as compared to that of the kids born to does without supplementation.

Monthly blood samples were collected from adult does and kids for haematological and biochemical analysis (blood glucose, total cholesterol, triglyceride, blood urea nitrogen, phosphorus and calcium). The mean red blood cell count, haemoglobin content, white blood cell count, plasma glucose, total protein and blood urea content, plasma total cholesterol, triglycerides levels, calcium and phosphorous levels in the does were not influenced by feeding of concentrate or WBSG and the mean values had no significant variation among the treatment groups. Plasma samples were analysed for hormones (progesterone, estrogen, cortisol and thyroid hormones) by radioimmunoassay. The mean values of plasma progesterone, estrogen, cortisol and  $T_3$  and  $T_4$  in the Salem Black does were not influenced by the supplementation of either concentrate or WBSG.

Milk yield and composition (fat, lactose, proteins and total solids) were evaluated. Milk and meat fatty acids profile were determined by gas chromatography. The mean total milk yield of T4 group was significantly ( $p < 0.05$ ) higher compared to all the other treatment groups of does. Milk fat, milk lactose and total solids per cent upto 90 days and solids not fat per cent upto 45 days of lactation were increased by WBSG supplementation to does in comparison to control. Similarly 100 per cent supplementation with WBSG significantly decreased the milk  $C_{10:0}$  (capric acid) and  $C_{16:0}$  (palmitic acid) fatty acids and milk short chain fatty acids level but increased the  $C_{18:0}$  (stearic acid),  $C_{18:1}$  (oleic acid), LCFA and decreased the SFA: LCFA ratio as compared to the control.

Weekly body weight of kids (born to the does of respective treatment groups) and feed consumption were recorded. Growth performance and average daily gain were calculated.

Feeding of concentrate or WBSG to the Salem Black kids did not have any significant influence on the mean red blood cell count, haemoglobin content, packed cell volume and white blood cell count, mean plasma glucose, total protein and plasma total cholesterol, HDL, LDL cholesterol and triglycerides

levels. Blood urea level in kids was elevated in born to does of T4 group when compared to the control kids.

The DMI of kids born to group T4 does was significantly ( $p < 0.05$ ) lower compared to control group. The body weight was significantly ( $p < 0.05$ ) higher for the kids of 100 per cent WBSG supplemented does. Likewise, the average daily body weight gain (g) was higher ( $p < 0.05$ ) and feed to gain ratio was lower ( $p < 0.05$ ) in these kids compared to control.

The growth hormone and IGF - I levels in the kids of T4 group showed a significant ( $p < 0.05$ ) increase as compared to the T1 group kids. The mean values of thyroid hormones  $T_3$  and  $T_4$  were almost similar in all the treatment groups of Salem Black kids from the third to the sixth month of age.

Carcass characteristics were studied after slaughter of the kids at 6 months of age. The mean dressing per cent of the kids supplemented with WBSG (100%) was significantly ( $p < 0.05$ ) higher and the per cent of total inedible parts was least in the kids supplemented with WBSG (100%) as compared to the kids in the control group.

Supplementation of WBSG at 100 per cent level caused a significant ( $p < 0.05$ ) increase in the *Longissimus dorsi* muscle fatty acids  $C_{18:1}$  (oleic acid),  $C_{18:2}$  (linoleic acid), MUFA, PUFA, PUFA:SFA ratio and significantly decreased  $C_{16:0}$  (palmitic),  $C_{18:0}$  (stearic acid) and SFA level as compared to the control.

The present study indicated that supplementing WBSG in the diet of kids significantly reduced the feed cost. The weight gain per unit cost was highest in T4, followed by the T3, control and T2 groups thus indicating that supplementing WBSG in the diet resulted in better profitability without having any adverse effects on the productive and reproductive performance in Salem Black goats.