THE EFFECT OF FEEDING PROBIOTICS ON THE PRODUCTIVE PERFORMANCE OF SAUDI ARABIA SHEEP BREEDS DURING FATTENING

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ABSTRACT

This study was carried out on 48 weaned male lambs from 3 different indigenous Saudi Arabian sheep breeds (Awassi, Najdi, and Najdi crossbred) in a 3x2 factorial design to evaluate the effect of feeding probiotics (BIO-NUTRA - Direct Fed Microbes, DFM) on growth performance, carcass quality, serum biochemical and hematological parameters, during fattening. Fattening lambs were slaughtered at 6 months of age (45 Kgs average live weight).

The obtained results showed that DFM increased weights (P<0.05) of Awassi lambs at 4 months (25.17 vs. 22.67 kgs) and Najdi crossbred at 5 - 6 months of age (32.75 vs. 27.6 & 44.63 vs. 41.4 Kgs) when compared with control ones. Average daily gain of DFM-supplemented Najdi crossbred was subsequently noticed at 4 - 5 and 3 - 6 month periods (0.33 vs. 0.18 & 0.32 vs. 0.28 kg). Differences in body conformation due DFM supplement were significant for body length in Awassi (56 vs. 45 cm) and Najdi (61.8 vs. 49.5 cm), and height in Najdi (74.67 vs. 67 cm) as well as its crossbred (70.5 vs. 65.67 cm) when compared with their control groups.

Moreover, the results revealed that probiotics have a positive effect on carcass characteristics. Awassi lambs had the highest dressing % (53.16%), while Najdi control was the lowest (46.52%). On the average, DFM lambs super passed the control ones (P<0.05) in shoulder & forearm weight% (4.18 vs. 3.74 %), Rack weight% (3.59 vs. 3.2%), and tail fat weight % (8.78 vs. 6.11%), but decreased pluck weight% (3.75 vs. 4.18%), leg weight% (6.9 vs. 7.3 %), and meat bone ratio (3.07 vs. 3.57). Genotype by DFM interaction was also evident in Awassi shoulder & forearm weight%, tail fat weight %, fur weight %, and carcass length, as well as Najdi crossbred Pluck weight%, and leg weight %.

Evaluation of blood cellular elements and serum biochemical analysis revealed no significant effect due to DFM supplement, except for monocytes and total protein on the whole average (0.55 vs. 0.92 $x10^3/\mu$& 8.26 vs. 9.36 g/dl). MCH and glucose in Najdi (7.55 vs. 8.5 pg & 69.98 vs. 94.65 mg/dl), MCHC in Awassi (28.3 vs. 26.97 g/dl), and glucose compared to control groups. It would be concluded that DFM may be more

economically beneficial for the sheep breeders and the increased meat produced locally can help reduce the need for sheep importing from abroad.

Key words: *Probiotics, sheep, growth, carcass, hemogram, serum biochemical traits*

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INTRODUCTION

Lamb growth and development is affected by its genetic makeup **(El-Barody et al., 2002)**, and environment particularly feeding practices and growth promoters **(Andrighitto et al., 1993; Abd El-Ati et al., 2002)**. Breeding effect has shown to be beneficial for commercial lamb production and the incorporation of a live culture in lamb ration is relatively recent, and **El-Shamaa (2002)** found them promising.

One of the best feed additives not only for sheep ration but also for all ruminant rations is the probiotics or Direct Fed Microbial (DFM), which are viable microbial cultures and enzyme preparations that beneficially affect the animal by improving its intestinal microbial balance **(Fuller 1989)**. Moreover, manipulating rumen digestion system through the addition of DFM and a fibrolytic enzymes to ruminant rations so as to enhance cellulose digestion and improve the animal performance had been investigated and documented by **Nocek, et al. (2003), Haddad and Goussous (2005), fadel Elsaeed & Abusamra (2007), loing (2007) and Musa, et al. (2009)**.

DFM have been shown to increase the feed efficiency and daily gain in feedlot cattle and improve health and performance of young calves **(Krehhlel et al. 2003)**. **Jayahal, et al. (2008)** presumed that DFM supplements improved the animal production performance, increased body weight, average daily gain, body length, height, and heart girth of probiotic supplemented kids more than control groups. In addition, USDA report (2008) indicated that DFM feed containing viable natural occurring microorganisms improved calves average daily gain up to 20%.

There are many types of bacterial DFM with the most known ones are preparations which containing Lactobacillus strains, Bacillus subtilis NATO, Allicin, hydrolytic enzymes and ginseng extract **(El-Ashry et al., 1994 and Ashraf. et al., 1999)**. However, their effect on performance depends upon several factors and their real mode of action is still unknown in sheep fattening and need further investigations in order to clarify their effect on growth, carcass and blood parameters.

On the other hand, DFM research has been in general carried out under temperate conditions on wool large frame sheep breeds, and its effect on Saudi Arabia sheep breeds under tropical conditions has been poorly approached. Therefore, the objective of the proposed study was to evaluate the effects of feeding probiotics (Direct Fed Microbial) on the growth, carcass quality, and serum biochemical & hematological parameters of Saudi Arabia lambs from three different indigenous sheep breeds during fattening.

MATERIAL AND METHODS

This research projeet (financially supported by Deanship of Scientific Research) was conducted to assess the growth performance, carcass and blood parameters of Saudi Arabia lambs supplemented with probiotic microbial culture at the Agriculture and Veterinary Training and Research Station of King Faisal University in Al-Hassa.

Experimental Sheep and Housing:

48 recently weaned male lambs (average weight 19.5 ± 0.5 kgs.), from indigenous Saudi Arabia Sheep breeds, namely Awassi (A), Najedi (N) and Najdi crossbred (NC) were randomly selected (physically and clinically healthy) and purchased from Al-Khaldia Farm at Riyadh. 8 Lambs from each breed were housed in aluminum shaded and fenced pen (4x4 m^2) supplied with water trough and feed bunks. In the first day all lambs were vaccinated against hemorrhagic septicemia and pneumonia with a live tissue culture vaccine, injected with a broad spectrum antibiotic & Ivomac and drenched a broad speetrum anthelmintic (as recommended by the manufacturing company) **(El-Sammani et al., 1992)**.

Ration and Experimental Diet:

Each breed group lambs were ear tagged and adapted to the control ration for 2 weeks, then assigned randomly to either control or experimental fattening ration (Table 1) for 3 months. Treated group were fed on the same control ration with the inclusion of 0.07% BIO-NUTRA (active fermentation probiotic, AMECO-BIOS & CO) BIO-NUTRA consists in a proprietary blend of Saccharomyces Cerevisae strains and Kluyveromyces Fragilis multi spores strain of yeast, and Lactobacillus (Bacillus Subtilius), Aspergillus oryzae fermented and reinforced digestive enzymes (Amylase, Protease, Cellulase, Lipase).

Table 1: Fattening lamb ration for both control and treated groups.

Feed Ingredients	Control	Treated
Yellow Corn	30	30
Barley grain	57.15	50.08
Soybean meal (48%)	7	7
Lime Stone	2.25	2.25
Salt	0.5	0.5
Mineral & Vit. Premix	0.1	0.1
Molasses	3	3.0
Bio-Nutra	-	0.07
Total	100.0	100.0

Total protein = 13%, Crude Fat = 2.5%, Crude Fiber = 6%,
Ca =1%, Ph = 0.6% TDN = 80%
(National Feed Company FEEDCO, Riyadh)

Lambs of each group were fed (4% of body weight, NRC, 1985) twice daily (half quantity) at 8 am and 3 pm with free acecss to forage (offered onee daily) and clean fresh water. Salt roek licks with higher content of copper to avoid its deficiency as recommended by **El-Sammani et al. (1992)**.

Data Collection:

Body weights and body dimensions will be recorded monthly throughout the fattening period which lasted for 8 months. The measurements will be as follows:

- Body weight (kg), recorded every 4 weeks on early morning (empty stomached lambs).
- Average daily gain (ADG) was calculated as the difference between two successive weights divided by the time period (days).
- Relative growth rate was calculated according to **Broody (1945)** as the following formula:

$$RGR\% = 100(W2 - W1)\ ^1/_2\ (W2+W1)$$

Where W1 and W2 are body weights at the beginning and the end of a period

Carcass quality and Body Conformation:

At the end of the experiment, 3 lambs from each group were randomly chosen and slaughtered **(El-Sammani et al., 1992)**. Live body weight, and body conformation were recorded before slaughtering.

- Body length (em): the distance between points of shoulders to pin bone.
- Height at withers (cm): the vertical distance from point of withers to the ground.
- Chest girth: the circumference of the chest just behind the shoulder.
- Hip width (em):Tuber coxae distance: the length between the two points of hips.
- Length of eannon bone (cm): the length from below the knee to the point of fetlock.

Hot carcass weights, lengths, girth (chest and leg), organ weights (head, feet, skin, alimentary, tests, kidneys, spleen, pluek (trachea, lung, liver, heart), meat and bones (left half of the carcass), and tail fats) as well as their relative weights will be recorded.

Blood samples :

Two types of blood samples were obtained from each lamb before slaughtering through jugular vein puncture.

A) The first blood samples were obtained in vaccutainer tubes with EDTA as anticoagulant and were used for earrying out hemogram or eomplete blood count (CBC) by using the electronic eell counter (UDIHEM-UDI). These parameters included:

Total erythrocytic count (RBCs), Hemoglobin concentration (Hb), Packed cell volume (PCV- HCT), Total leueocytic count (WBCs), Erythrocytie indices including (MCV, MCH, MCHC), Differential leucocytic count (monocytes, lymphoeytes, granulocytes) on a stained blood film using Giemsa stain **(Coles, 1986)**.

B) The second blood samples were obtained in plain vaccutainer tubes and used for obtaining serum for biochemical analysis of the selected parameters. These blood samples will be allowed to clot in room temperature for 1-2 hours the will be centrifuged at 3000 rpm for 30 minutes. Only elear and nonhemolysed serum will be obtained and kept frozen until used for biochemical analysis of the selected parameters **(Coles, 1986)**. The biochemical parameters of the blood sera samples included:

Calcium, Phosphorus, Magnesium, Total proteins, Albumin, Cholesterol, Glucose. Blood urea nitrogen, creatinine, and Liver enzymes (AST & ALT) .

The concentrations of the selected biochemical parameters were measured calorimetrically with auto analyzer (Ellipse-UDI) machine, using commercially available test kits **(Zak, 1958)**.

Statistical analyses :

Data were analyzed by the General Linear Model (GLM) procedure (SAS, Institute, Inc. 2002). The Least Square Mean (LSM) + standard errors will be calculated and tested for significance using the "t" test. Moreover, arc sine transformation will be done to percentage data **(Steel and Torrie, 1960)**.

Data will be analyzed by adapting the following models:

$Y_{ij} = \mu + Gi + Tij + Eij$

Y_{ij} is an observed value of the dependant variable.

μ is the over all mean, a constant common to all observations.

G_i is an effect due to ith genotype (sheep breed).

T_{ij} Effect of the jth treatment within the ith breed.

E_{ij} A random deviation due to unexplained sources of variation.

RESULTS AND DISCUSSION

Growth performance : Least squares means ± standard errors (SE) for the effect of probiotics (DFM) on growth performance of different sheep breeds are presented in Table 2. DFM on the average of sheep breeds did not improve body weight, gain or RGR of treated groups compared to the control ones. However DFM supplement (P<0.05) increased Awassi lambs body weights at 4 months of age (25.17 ± 0.19 kg) and Najdi crossbred at 5 (32.75 ± 1.29 kg) & 6 months (44.63 ± 1.28kg) when compared with their control groups (22.67 ± 1.76, 27.6 ± 1.03, 41.4 ± 1.17 kg, respectively). A finding that agree with (Rust et al. (2000) who found that bacterial (DFM) improved body weights and feed efficiency in feedlot cattle and calves. A similar trend was observed by **Jayabal et al. (2008)** while feeding probiotie to goat kids.

Moreover, average daily gain (ADG) and RGR of DFM supplemented Najdi crossbred was subsequently noticed (P<0.05) at 4 - 5 month period compared with control ones (0.33 vs. 0.18 kg & 35.29 vs. 21.49%). The same genotype gained more weight on daily average at 3 - 6 month (0.32 vs. 0.28 kg). **Fath-Allab (2006)** recorded that biogen supplemented crossbred lambs grew at a significant laster rate (0.36 ± 005 kg/day) than did non supplemented control group (0.243 ± 0.04 kg/day) between the 2nd and 4th weeks after treatment and had higher RGR from the 8^{th} - 10^{th} weeks of his experiment (15.14 vs. 12.29%).

Hematological and Serum Biochemical Analyses: Least squares means ± standard errors (SE) for the effect of probiotics (DFM) on hematological and serum biochemical analyses of different sheep breeds are presented in Tables 3 & 4. DFM supplement did not induee any signifieant differences in blood cellular elements on the whole average in comparison with the no supplemented ones (Table 3), exeept for monoeyte counts (P<0.05) (0.55 ± 0.12 vs. 0.92 ± 0.15 x10^3). A finding that agree with Fath Allah (2006) while working on Biogen on Barki sheep, but disagree with **Abdel Khalek et al. (2000)** while working on Lacto **Sacc and Metwally et al. (2002)** after the addition of Yeast culture supplement to ruminant diets.

Genotype by DFM supplement interaction was notieed (P<0.05) in Najdi crossbred RBCS counts which were the highest (18.61 x 10^6 / ul), but the lowest in Awassi lambs (15.62 x 10^6 / ul). Similar results were obtained for RBCS eount increase by Lacto Sacc supplement **(Kovacs et al., 1998)** and yeast culture **(Abdel Gawad et al., 2002)**. On the contrary, NCHC was the highest in Awassi lambs (28.3 ± 0.62 g/dl) and the lowest in Najdi crossbred (25.54 ± 0.42 g/dl). Moreover, DFM supplement decreased MCH of Najdi lambs (7.55 ± 0.15 pg) when eompared with their control group (8.5 ± 0.18 pg). A finding that would be due to copper deficiency as being postulated by **Coles (1986) and Neilsen (2004)** who explained the role of copper and provision of iron for hemoglobin synthesis.

Neither DFM supplement nor sheep genotype indueed significant effects on serum bioehemical picture, except for total protein on the whole average of sheep breeds as DFM decreased its concentration (8.3 ± 0.22 g/dl) in eomparison with the control one (9.33 ± 0.93 g/dl). Similar indications were recorded by **El-Ashry et al. (2001) and El-Shamaa (2002)**, after the addition of yeast culture to ruminant diets.

Although DFM supplement significantly decreased glucose level of Najdi lambs (60.98 ± 3.98 mg/dl) relative to their non DFM supplement group (94.65 ± 7.75 mg/dl), it inereased Najdi erossbred lamb cholesterol level (50.18 ± 3.84 mg/dl) more than both Najdi (40.7 ± 1.23mg/dl) and Awassi (42.68 ± 5.92 mg/dl) DFM supplement lambs (Table 4). These findings agree with **Mert et al. (1998) and El-Barody et al. (2002)** who dedueed significant differenees in eholesterol levels between sheep breeds but disagree with **Abdel Gawad et al. (2002)** who reported an increase in serum glucose levels in male kid goats supplemented with yeast culture more than control ones (P<0.05).

Body and Careass Measurements: The effects of DFM supplements to different sheep breeds on body and earcass measurements are listed in Table 5. On the whole average, regardless of fattened lamb breed, DFM supplementation increased body length, height at the withers, and cannon girth (56.13 ± 2.45, 68.88 ± 2.26, and 9.25 ± 0.31 cm) more than the non supplemented ones (48.17 ± 1.84, 65.56 ± 0.69, and 7.83 ± 0.2 cm, respeetively).

The same trend was noticed, within sheep genotype, feeding DFM increased Najdi lambs body length (23.9%) and height (11.5%), Awassi lambs height (24.5%), carcass length (13.7%), and carcass leg length (12.5%), and Najdi crossbred lambs height (7.9%) and carcass leg length (- 8.8%) more than their corresponding control groups. Moreover, DFM supplements increased body length (61.33 ± 0.67 cm), and height (74.33 ± 0.33 cm) of Najdi fattened lambs to the maximum compared to the other 2 genotypes.

Carcass Quality Traits: The effect of DFM addition to the ration of different sheep breeds on careass quality traits are presented in Table 6. Feeding DFM regardless of the sheep breed increased shoulder and forearm, Rack, and tail fat weight % (11.8, 12.2, and 35.8%) more than non supplemented ones, but decreased leg weight% (6.4%) and meat to bone ratio (16.3%). Genotype by feed supplement interaction maximized Awassi lambs dressing weight % (53.16%), head weight % (7.14%), and tail fat weight % (8.78%) more thau other sheep breed groups as well as control ones (Table 6), but Najdi Crossbred fattening lambs had the least slaughter weight (40.35 ± 2.85 kg) (P<0.05).

The observed changes in body measurements due to feeding DFM were also noticed by **Fath Allah (2006)** who found that Biogen treated Barki sheep had greater body length (65.05 vs. 62.8 cm), height (61.9 vs. 59.9 cm) and cannon girth (9.15 vs. 8.55 cm) compared to the non treated group. In addition, **Jayabal et al. (2008)** recorded that all body measurements of probiotics fed kid goats (final body length height at withers, and heart girth) differed significantly from their corresponding control groups. Although, **Musa et al. (2009)** pointed that probiotics enhaneed meat quantity (increased carcass output) and quality, **Whitley et al. (2008)** indicated that carcass weight, weight of fabricated cuts (shoulder, loin, leg, rack, shank, as well as carcass length and leg circumference were not influeneed (P>0.05) by probiotics supplementation to meat goats.

The decreased meat to bone ratio and increased tail fat % disagree with the findings of **Aerts et al. (1994)** who found that supplementation of living yeast significantly increased meat % in the carcass and the fat %. It would be concluded that DFM may be more economically beneficial for the sheep breeders and the increased meat produced locally can help reduce the need for sheep importing from abroad.

Table 2: Least squares means ± standard errors (SE) for the effect of probiotic (DFM) on growth performance of different sheep breeds.

TRAIT	BREED / TREATMENT	AWASSI Mean ± SE	NAJDI Mean ± SE	NAJDI CROSSBRED Mean ± SE	AVERAGE ± SE
4 month Weight	PROBIOTIC	25.17± 0.91 ^{ax}	26.13± 1.04 ^{abx}	22.88± 0.79 ^{acx}	24.68± 0.60 ^{a}
	CONTROL	22.67± 1.76 ^{ay}	26.75± 0.48 ^{bx}	22.20± 0.58 ^{ax}	23.83± 0.78 ^{a}
5 month Weight	PROBIOTIC	28.67± 1.12 ^{ax}	35.00± 1.40 ^{bx}	32.75± 1.29 ^{bx}	32.45± 0.91 ^{a}
	CONTROL	27.33± 2.33 ^{ax}	36.00± 1.47 ^{bx}	27.60± 1.03 ^{ay}	30.33± 1.44 ^{a}
6 month Weight	PROBIOTIC	42.50± 0.99 ^{ax}	46.00± 1.05 ^{bcx}	44.63± 1.28 ^{acx}	44.55± 0.70 ^{a}
	CONTROL	40.00± 1.73 ^{ax}	48.25± 1.65 ^{bx}	41.40± 1.17 ^{ay}	43.33± 1.31 ^{a}
3-4 month GAIN	PROBIOTIC	0.19± 0.04 ^{ax}	0.20± 0.02 ^{ax}	0.21± 0.02 ^{ax}	0.20± 0.02 ^{a}
	CONTROL	0.14± 0.01 ^{ax}	0.17± 0.02 ^{ax}	0.20± 0.03 ^{ax}	0.17± 0.02 ^{a}
4-5 month GAIN	PROBIOTIC	0.12± 0.04 ^{ax}	0.30± 0.03 ^{bx}	0.33± 0.03 ^{bx}	0.26± 0.03 ^{a}
	CONTROL	0.16± 0.03 ^{ax}	0.31± 0.06 ^{bx}	0.18± 0.04 ^{ay}	0.22± 0.03 ^{a}
5-6 month GAIN	PROBIOTIC	0.46± 0.05 ^{ax}	0.37± 0.05 ^{ax}	0.40± 0.04 ^{ax}	0.40± 0.03 ^{a}
	CONTROL	0.42± 0.04 ^{ax}	0.41± 0.09 ^{ax}	0.46± 0.06 ^{ax}	0.44± 0.04 ^{a}
3-6 month GAIN	PROBIOTIC	0.26± 0.01 ^{ax}	0.29± 0.01 ^{acx}	0.32± 0.02 ^{bcx}	0.29± 0.01 ^{a}
	CONTROL	0.24± 0.00 ^{ax}	0.29± 0.02 ^{ax}	0.28± 0.02 ^{ay}	0.27± 0.01 ^{a}
3-4 month RGR	PROBIOTIC	26.33± 5.29 ^{ax}	26.32± 2.09 ^{ax}	32.72± 3.79 ^{ax}	28.65± 2.13 ^{a}
	CONTROL	21.17± 0.64 ^{ax}	20.58± 2.81 ^{ax}	30.25± 5.30 ^{ax}	24.76± 2.64 ^{a}
4-5 month RGR	PROBIOTIC	12.91± 4.36 ^{ax}	28.99± 2.31 ^{bx}	35.29± 3.24 ^{bx}	26.90± 2.64 ^{a}
	CONTROL	18.56± 2.93 ^{ax}	29.21± 5.64 ^{ax}	21.49± 4.76 ^{ay}	23.33± 2.90 ^{a}
5-6 month RGR	PROBIOTIC	39.02± 4.31 ^{ax}	27.46± 4.26 ^{ax}	30.90± 3.44 ^{ax}	31.86± 2.42 ^{a}
	CONTROL	38.06± 4.87 ^{ax}	29.07± 6.58 ^{ax}	40.01± 4.98 ^{ax}	35.88± 3.31 ^{a}
3-6 month RGR	PROBIOTIC	75.06± 4.22 ^{ax}	78.82± 2.41 ^{ax}	92.06± 4.29 ^{bx}	82.61± 2.57 ^{a}
	CONTROL	74.62± 3.09 ^{ax}	75.51± 3.30 ^{ax}	86.50± 4.57 ^{ax}	79.87± 2.73 ^{a}

Weight = Body weight RGR = Relative Growth Rate

$^{a-c}$ different letters between sheep breeds within treatment (raw) are significant (P<0.05)

$^{x-y}$ different letters between treatment (column) within sheep breed are significant (P<0.05)

Table 3: Least squares means ± standard errors (SE) for the effect of probiotic (DFM) on Hematological (Blood cellular elements) characters of different sheep breeds.

TRAIT	BREED / TREATMENT	AWASSI Mean ± SE	NAJDI Mean ± SE	NAJDI CROSSBRED Mean ± SE	AVERAGE ± SE
WBCS	PROBIOTIC	10.10± 1.68 ^{ax}	10.86± 0.77 ^{ax}	8.85± 1.06 ^{ax}	9.97± 0.66 ^{a}
$X10^3$	CONTROL	10.63± 0.54 ^{ax}	12.59± 1.05 ^{ax}	11.54± 1.44 ^{ax}	11.66± 0.69 ^{a}
LYMPH	PROBIOTIC	4.59± 0.86 ^{ax}	4.06± 0.43 ^{ax}	3.83± 0.64 ^{ax}	4.14± 0.35 ^{a}
$X10^3$	CONTROL	4.44± 0.49 ^{ax}	5.14± 0.82 ^{ax}	4.61± 0.82 ^{ax}	4.74± 0.43 ^{a}
MONOC	PROBIOTIC	0.50± 0.19 ^{ax}	0.74± 0.20 ^{ax}	0.36± 0.23 ^{ax}	0.55± 0.12 ^{a}
$X10^3$	CONTROL	1.17± 0.12 ^{ax}	0.82± 0.30 ^{ax}	0.84± 0.27 ^{ax}	0.92± 0.15 ^{b}
GRANUL	PROBIOTIC	5.05± 0.88 ^{ax}	6.08± 0.48 ^{ax}	4.68± 0.63 ^{ax}	5.32± 0.38 ^{a}
$X10^3$	CONTROL	5.06± 0.18 ^{ax}	6.67± 1.16 ^{ax}	6.11± 0.93 ^{ax}	6.03± 0.54 ^{a}
RBCS	PROBIOTIC	15.62± 0.94 ^{ax}	16.49± 0.52 ^{acx}	18.61± 1.61 ^{bcx}	16.95± 0.66 ^{a}
$X10^6$	CONTROL	16.67± 0.99 ^{ax}	15.13± 0.29 ^{ax}	16.76± 1.33 ^{ax}	16.19± 0.61 ^{a}
HGB	PROBIOTIC	12.45± 0.50 ^{ax}	12.43± 0.24 ^{ax}	13.96± 1.12 ^{ax}	12.94± 0.42 ^{a}
g/dl	CONTROL	12.37± 0.35 ^{ax}	12.93± 0.32 ^{ax}	12.58± 0.71 ^{ax}	12.64± 0.31 ^{a}
HCT %	PROBIOTIC	44.20± 2.29 ^{ax}	47.78± 1.54 ^{ax}	54.81± 4.64 ^{ax}	49.10± 1.94 ^{a}
	CONTROL	45.87± 1.27 ^{ax}	48.03± 2.10 ^{ax}	49.08± 2.33 ^{ax}	47.93± 1.20 ^{a}
MCV	PROBIOTIC	28.50± 0.81 ^{ax}	29.00± 0.82 ^{ax}	29.43± 0.30 ^{ax}	29.00± 0.39 ^{a}
	CONTROL	27.33± 1.45 ^{ax}	31.50± 1.19 ^{ax}	29.60± 1.60 ^{ax}	29.67± 0.92 ^{a}
MCH	PROBIOTIC	8.02± 0.24 ^{ax}	7.55± 0.15 ^{ax}	7.53± 0.11 ^{ax}	7.68± 0.10 ^{a}
P9	CONTROL	7.40± 0.25 ^{ax}	8.50± 0.18 ^{by}	7.56± 0.26 ^{ax}	7.83± 0.19 ^{a}
MCHC	PROBIOTIC	28.3± 0.62 ^{ax}	26.1± 0.58 ^{bx}	25.5± 0.42 ^{bx}	26.5± 0.39 ^{a}
g/dl	CONTROL	27.0± 0.52 ^{ax}	27.0± 0.60 ^{ax}	25.6± 0.63 ^{ax}	26.4± 0.39 ^{a}

HGB=Hemoglobin HCT (PCV) % = Packed cell volume MCV=Mean corpuscle volume

MCH= Mean corpuscle hemoglobin MCHC = Mean corpuscle hemoglobin concentration

$^{a-c}$ different letters between sheep breeds within treatment (raw) are significant ($P<0.05$)

$^{x-y}$ different letters between treatment (column) within sheep breed are significant ($P<0.05$)

Table 4: Least squares means ± standard errors (SE) for the effect of probiotic (DFM) on Serum biochemical analysis of different sheep breeds

TRAIT	BREED / TREATMENT	AWASSI Mean ± SE	NAJDI Mean ± SE	NAJDI CROSSBRED Mean ± SE	AVERAGE Mean ± SE
BUN mg/dl	PROBIOTIC	25.43± 2.68 ^{ax}	25.64± 1.74 ^{ax}	22.88± 0.93 ^{ax}	24.89± 1.09 ^{x}
	CONTROL	23.63± 2.91 ^{ax}	29.95± 4.45 ^{ax}	26.20± 0.20 ^{ax}	26.17± 1.81 ^{x}
CREATININ mg/dl	PROBIOTIC	0.83± 0.05 ^{ax}	0.74± 0.10 ^{ax}	0.98± 0.19 ^{ax}	0.82± 0.07 ^{x}
	CONTROL	0.93± 0.48 ^{ax}	0.50± 0.00 ^{ax}	0.85± 0.05 ^{ax}	0.79± 0.20 ^{x}
CHOLESTROL mg/dl	PROBIOTIC	42.68± 5.92 ^{ax}	40.70± 1.23 ^{abx}	50.18± 3.84 ^{acx}	43.56± 1.96 ^{x}
	CONTROL	51.50± 4.13 ^{ax}	50.65± 9.45 ^{ax}	48.15± 0.15 ^{ax}	50.30± 2.65 ^{x}
ALT /l	PROBIOTIC	29.45± 3.38 ^{ax}	28.10± 2.50 ^{ax}	25.43± 6.88 ^{ax}	27.77± 2.13 ^{x}
	CONTROL	25.67± 2.29 ^{ax}	31.75± 1.75 ^{ax}	23.90± 0.10 ^{ax}	26.90± 1.60 ^{x}
AST /l	PROBIOTIC	237.4± 155 ^{ax}	75.54± 6.28 ^{ax}	88.20± 17.38 ^{ax}	119.16± 39.20 ^{x}
	CONTROL	75.47± 5.01 ^{ax}	73.55± 4.25 ^{ax}	81.75± 0.25 ^{ax}	76.71± 2.50 ^{x}
MAGNESIUM mg/dl	PROBIOTIC	0.68± 0.05 ^{ax}	0.93± 0.18 ^{ax}	0.55± 0.13 ^{ax}	0.77± 0.10 ^{x}
	CONTROL	0.67± 0.07 ^{ax}	0.80± 0.10 ^{ax}	0.95± 0.05 ^{ax}	0.79± 0.06 ^{x}
PHOSPHRUS mg/dl	PROBIOTIC	4.75± 0.18 ^{ax}	4.64± 0.39 ^{ax}	5.00± 0.56 ^{ax}	4.76± 0.23 ^{x}
	CONTROL	4.40± 0.99 ^{ax}	4.55± 1.35 ^{ax}	6.15± 0.15 ^{ax}	4.94± 0.57 ^{x}
CALCIUM mg/dl	PROBIOTIC	6.88± 0.71 ^{ax}	7.69± 0.41 ^{ax}	6.93± 0.98 ^{ax}	7.29± 0.35 ^{x}
	CONTROL	7.90± 0.84 ^{ax}	6.70± 0.20 ^{ax}	8.15± 0.15 ^{ax}	7.63± 0.40 ^{x}
GLUCOSE mg/dl	PROBIOTIC	73.23± 4.12 ^{ax}	69.98± 3.98 ^{ax}	76.28± 7.36 ^{ax}	72.36± 2.78 ^{x}
	CONTROL	71.17± 1.67 ^{ax}	94.65± 7.75 ^{by}	64.85± 0.15 ^{ax}	76.07± 5.24 ^{x}
ALBUMIN g/dl	PROBIOTIC	3.75± 0.53 ^{ax}	3.65± 0.19 ^{ax}	3.43± 0.42 ^{ax}	3.62± 0.18 ^{x}
	CONTROL	3.83± 0.75 ^{ax}	3.75± 0.85 ^{ax}	3.60± 0.10 ^{ax}	3.74± 0.34 ^{x}
TOT PROTEIN g/dl	PROBIOTIC	8.13± 0.66 ^{ax}	8.45± 0.24 ^{ax}	8.20± 0.51 ^{ax}	8.31± 0.22 ^{x}
	CONTROL	9.13± 0.24 ^{ax}	10.35± 1.15 ^{ax}	8.60± 0.10 ^{ax}	9.33± 0.39 ^{y}

AST=Aspartate aminotransferase ALT=Alanine aminotransferase

BUN=Blood urea nitrogen

$^{a-c}$ different letters between sheep breeds within treatment (raw) are signifieant (P<0.05)

$^{x-y}$ different letters between treatment (column) within sheep breed are significant (P<0.05)

Table 5: Least squares means ± standard errors (SE) for the effect of probiotic (DFM) on Body and carcass measurements (cm) of different sheep breeds.

TRAIT	BREED / TREATMENT	AWASSI Mean ± SE	NAJDI Mean ± SE	NAJDI CROSSBRED Mean ± SE	AVERAGE ±SE
BODY MEASUREMENTS					
BODY LENGTH	PROBIOTIC	56.00± 3.51 ^{ax}	61.33± 0.67 ^{abx}	48.50± 5.50 ^{acx}	56.13± 2.45 ^{a}
	CONTROL	45.00± 1.73 ^{ay}	49.50± 5.48 ^{ay}	50.00± 0.00 ^{ax}	48.17± 1.84 ^{b}
WITHER HEIGHT	PROBIOTIC	62.00± 1.53 ^{ax}	74.67± 0.33 ^{bx}	70.50± 3.50 ^{bx}	68.88± 2.26 ^{a}
	CONTROL	64.00± 0.58 ^{ax}	67.00± 1.73 ^{ay}	65.67± 0.33 ^{ay}	65.56± 0.69 ^{b}
HIP WIDTH	PROBIOTIC	37.00± 1.53 ^{ax}	37.67± 2.60 ^{ax}	33.50± 2.50 ^{ax}	36.38± 1.27 ^{a}
	CONTROL	39.00± 0.58 ^{ax}	34.50± 0.87 ^{ax}	35.00± 2.89 ^{ax}	36.17± 1.14 ^{a}
HEART GIRTH	PROBIOTIC	75.33± 7.69 ^{ax}	66.00± 16.56 ^{ax}	78.00± 1.00 ^{ax}	72.50± 6.29 ^{a}
	CONTROL	91.00± 3.46 ^{ax}	86.00± 0.58 ^{ax}	83.50± 0.87 ^{ax}	86.83± 1.52 ^{a}
CANON GIRTH	PROBIOTIC	9.33± 0.33 ^{ax}	9.33± 0.67 ^{ax}	9.00± 1.00 ^{ax}	9.25± 0.31 ^{a}
	CONTROL	8.00± 0.00 ^{ax}	7.50± 0.29 ^{ay}	8.00± 0.58 ^{ax}	7.83± 0.20 ^{b}
CANON LENGTH	PROBIOTIC	15.33± 0.33 ^{ax}	18.00± 2.00 ^{ax}	16.00± 1.00 ^{ax}	16.50± 0.82 ^{a}
	CONTROL	12.50± 1.44 ^{ax}	20.00± 2.89 ^{bcx}	16.50± 0.87 ^{acx}	16.33± 1.45 ^{a}
CARCASS MEASUREMENTS					
CARCASS LENGTH	PROBIOTIC	67.67± 0.67 ^{ax}	74.33± 0.88 ^{bx}	67.50± 0.50 ^{ax}	70.13± 1.29 ^{a}
	CONTROL	59.50± 2.60 ^{ay}	76.00± 0.58 ^{bx}	71.00± 0.58 ^{bx}	68.83± 2.57 ^{a}
LEG LENGTH	PROBIOTIC	45.00± 1.00 ^{ax}	48.00± 2.00 ^{ax}	45.50± 0.50 ^{ax}	46.25± 0.90 ^{a}
	CONTROL	40.00± 0.00 ^{aY}	50.00± 5.77 ^{bx}	49.50± 1.44 ^{bY}	46.50± 2.37 ^{a}
CHEST CIRCUMFERNCE	PROBIOTIC	71.67± 0.33 ^{ax}	72.33± 0.88 ^{abx}	69.00± 1.00 ^{acx}	71.25± 0.62 ^{a}
	CONTROL	69.50± 2.02 ^{ax}	72.83± 0.17 ^{bcx}	72.00± 0.00 ^{acx}	71.44± 0.77 ^{a}
LEG CIRCUMFERNCE	PROBIOTIC	52.33± 1.33 ^{ax}	55.33± 0.67 ^{ax}	50.50± 1.50 ^{ax}	53.00± 0.93 ^{a}
	CONTROL	54.00± 1.15 ^{ax}	62.50± 1.44 ^{ax}	44.00± 6.93 ^{bx}	53.50± 3.38 ^{a}

$^{a-c}$ different letters between sheep breeds within treatment (raw) are significant (P<0.05)

$^{x-y}$ different letters between treatment (column) within sheep breed are significant (P<0.05)

Table 6: Least squares means ± standard errors (SE) for the effect of probiotic (DFM) on Carcass characteristics of different sheep breeds

TRAIT	BREED / TREATMENT	AWASSI Mean ± SE	NAJDI Mean ± SE	NAJDI CROSSBRED Mean ± SE	AVERAGE ± SE
SLAUGHTER WEIGHT (KG)	PROBIOTIC	47.13± 1.96 ^{ax}	48.67± 0.33 ^{ax}	40.35± 2.85 ^{bx}	46.01± 1.52 ^{a}
	CONTROL	46.53± 1.75 ^{ax}	49.00± 1.15 ^{ax}	44.60± 0.70 ^{ax}	46.71± 0.90 ^{a}
DRESSING WEIGHT%	PROBIOTIC	53.16± 0.96 ^{ax}	47.20± 2.20 ^{bcx}	48.92± 4.79 ^{acx}	49.87± 1.56 ^{a}
	CONTROL	48.64± 2.53 ^{ax}	46.52± 0.20 ^{ax}	48.96± 0.32 ^{ax}	48.04± 0.83 ^{a}
HEAD WEIGHT%	PROBIOTIC	7.14± 0.33 ^{ax}	5.99± 0.13 ^{bcx}	6.65± 0.28 ^{acx}	6.59± 0.23 ^{a}
	CONTROL	6.59± 0.26 ^{ax}	5.88± 0.29 ^{ax}	6.51± 0.10 ^{ax}	6.33± 0.16 ^{a}
SKIN WEIGHT%	PROBIOTIC	10.92± 0.75 ^{ax}	9.07± 0.43 ^{bx}	8.54± 0.26 ^{bx}	9.63± 0.48 ^{a}
	CONTROL	13.18± 0.69 ^{ay}	7.95± 0.81 ^{bx}	9.87± 0.10 ^{cx}	10.33± 0.82 ^{a}
KIDNEY WEIGHT%	PROBIOTIC	0.73± 0.27 ^{ax}	0.72± 0.10 ^{ax}	0.73± 0.20 ^{ax}	0.73± 0.10 ^{a}
	CONTROL	0.49± 0.11 ^{ax}	0.87± 0.11 ^{ax}	0.84± 0.11 ^{ax}	0.74± 0.08 ^{a}
TAIL FAT WEIGHT%	PROBIOTIC	8.78± 1.21 ^{ax}	2.40± 0.08 ^{bx}	2.97± 0.97 ^{bx}	4.93± 1.21 ^{a}
	CONTROL	6.11± 0.24 ^{ay}	2.04± 0.01 ^{bx}	2.74± 0.32 ^{bx}	3.63± 0.64 ^{b}
PLUCK WEIGHT%	PROBIOTIC	4.07± 0.41 ^{ax}	4.21± 0.14 ^{ax}	4.76± 0.22 ^{ax}	4.29± 0.18 ^{a}
	CONTROL	4.42± 0.16 ^{ax}	4.29± 0.01 ^{ax}	5.56± 0.31 ^{bx}	4.76± 0.23 ^{a}
NECK WEIGHT%	PROBIOTIC	4.00± 0.50 ^{ax}	3.90± 0.18 ^{ax}	3.57± 0.37 ^{ax}	3.86± 0.20 ^{a}
	CONTROL	3.22± 0.05 ^{ax}	3.45± 0.33 ^{ax}	3.70± 0.14 ^{ax}	3.46± 0.13 ^{a}
SHOULDER WEIGHT%	PROBIOTIC	4.05± 0.16 ^{ax}	4.35± 0.15 ^{ax}	4.14± 0.14 ^{ax}	4.18± 0.09 ^{a}
	CONTROL	3.41± 0.11 ^{ay}	3.54± 0.35 ^{ay}	4.26± 0.03 ^{bx}	3.74± 0.17 ^{b}
CHUCK WEIGHT%	PROBIOTIC	6.78± 0.31 ^{ax}	6.88± 0.16 ^{ax}	7.06± 0.13 ^{ax}	6.89± 0.12 ^{a}
	CONTROL	6.66± 0.13 ^{ax}	6.46± 0.68 ^{ax}	7.13± 0.08 ^{ax}	6.75± 0.23 ^{a}
RACK WEIGHT%	PROBIOTIC	3.76± 0.22 ^{ax}	3.46± 0.22 ^{ax}	3.51± 0.31 ^{ax}	3.59± 0.13 ^{a}
	CONTROL	3.29± 0.08 ^{ax}	3.21± 0.13 ^{ax}	3.09± 0.21 ^{ax}	3.20± 0.08 ^{b}
LOIN WEIGHT%	PROBIOTIC	3.39± 0.32 ^{ax}	3.39± 0.20 ^{ax}	3.45± 0.25 ^{ax}	3.41± 0.13 ^{a}
	CONTROL	2.68± 0.10 ^{ax}	5.01± 2.09 ^{ax}	2.75± 0.06 ^{ax}	3.48± 0.71 ^{a}
LEG WEIGHT%	PROBIOTIC	6.78± 0.37 ^{ax}	7.19± 0.26 ^{ax}	6.67± 0.27 ^{ax}	6.90± 0.18 ^{a}
	CONTROL	6.29± 0.11 ^{ax}	7.83± 0.16 ^{bx}	7.90± 0.07 ^{by}	7.34± 0.27 ^{b}
MEAT BONE RATIO	PROBIOTIC	3.35± 0.07 ^{ax}	2.90± 0.14 ^{ax}	2.89± 0.39 ^{ax}	3.07± 0.12 ^{a}
	CONTROL	4.59± 0.41 ^{ay}	3.04± 0.42 ^{bx}	3.08± 0.11 ^{bx}	3.57± 0.31 ^{b}

$^{a-c}$ different letters between sheep breeds within treatment (raw) are significant ($P<0.05$)

$^{x-y}$ different letters between treatment (column) within sheep breed are significant ($P<0.05$)

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الملخص العربى

تأثير تغذية محفزات النمو الحيوية على الكفاءة الإنتاجية

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أجريت هذه الدراسة على ٤٨ حمل ذكر حديثى الفطام من ثلاث سلالات محلية سعودية (عواسى - نجدى وخليط النجدى) فى تجربة متعددة التقسيمات (٢×٣) لتقييم تأثير تغذية محفزات النمو على كفاءة النمو وصفات الذبيحة وبعض قياسات الدم والسيرم خلال فترة التسمين، وتم ذبح حملان التسمين عند عمر ٦ أشهر (متوسط وزن ٤٥ كج).

وقد أظهرت النتائج أن تغذية محفزات النمو الحيوية زادت من وزن حملان العواسى عند عمر ٤ أشهر (١٧ر٢٥كجم) مقابل ٦٧ر٢٢كجم للمجموعة الضابطة وكذا حملان خليط النجدى عند عمر ٥ & ٦ أشهر (مقابل ٦ر٢٧ & ٦٣ر٤٤ مقابل ٤ر٤١كجم على التوالى). كما أظهرت حملان النجدى الخليطة متوسط معدل زيادة يومى عالى تبعاً لوزن الجسم السابق (٣٣ر٠ مقابل ١٨ر٠ & ٣٢ر٠كجم) مقارنة بالمجموعة الضابطة.

لوحظ وجود اختلافات معنوية فى فروقات مقاييس الجسم وصفات الذبيحة نتيجة إضافة محفزات النمو الحيوية لطول الجسم فى حملان العواسى (٥٦سم مقابل ٤٥سم) & نجدى (٨ر٦١ مقابل ٥ر٤٩سم) وكذا ارتفاع الجسم فى النجدى (٦٧ر٧٤ مقابل ٦٧سم) وخليط النجدى (٥ر٧٠ مقابل ٦٧ر٦٥سم) بالمقارنة للمجموعات الضابطة المرادفة. كانت حملان العواسى الأعلى نسبة تصافى (١٦ر٥٣٪) بينما مجموعة النجدى الضابطة الأقل (٥٢ر٤٦٪).

سجل المتوسط العام لتأثير محفزات النمو زيادة ملحوظة فى نسبة وزن الكتف والعضد (١٨ر٤ مقابل ٧٤ر٣٪) ووزن الضلوع والظهر (٥٩ر٣ مقابل ٢ر٣٪ ووزن دهن الذيل (٧٨ر٨ مقابل ١١ر٦٪) ولكن كان هناك نقص معنوى فى نسبة وزن المعلاق (٧٥ر٣ مقابل ١٨ر٤٪) ووزن الفخذ (٩ر٦ مقابل ٢ر٧٪) ونسبة وزن اللحم للعظم (٠٧ر٣ مقابل ٥٧ر٣٪) مقارنة بالمجموعات الضابطة المرادفة، ولقد تفوقت التراكيب الوراثية المغذاة بالمحفزات معنوياً عن الضابطة لحملان العواسى (نسبة وزن الكتف والعضد - وزن دهن الذيل وزن الفرو وطول الذبيحة)وخليط النجدى (نسبة وزن المعلاق والفخذ).

لم يظهر المتوسط العام لتراكيب الدم الخلوية أو صفات السيرم البيوكيميائية أى اختلاف معنوى نتيجة المحفزات ماعدا عدد الخلايا وحدة النراة (٥٥ر٠ مقابل ٩٢ر٠ ^٣١٠) وكمية البروتين الكلى (٢٦ر٨ مقابل ٣٦ر٩ جم/ديسيلتر) وكذا متوسط الهيموجلوبين فى كريات الدم

الحمراء والجلوكوز فى حملان النجدى (٥٥ر٧ مقابل ٥ر٨ & ٩٨ر٦٩ مقابل ٦٢ر٩٤ مجم/ديسيلتر) وأيضاً متوسط تركيز الهيموجلوبين فى الدم فى حملان العواسى (٣ر٢٨ مقابل ٩٧ر٢٦جم / ديسيلتر) مقارنة بالمجموعات الضابطة المرادفة. ويمكن التلخيص أن محفزات النمو الحيوية قد تكون ذات منفعة تجارية لمربى الأغنام وزيادة اللحوم المنتجة محلياً لتقليل الحاجة للاستيراد من خارج المملكة العربية السعودية.