A newly developed pectinase from *Aspergillus terreus* enhanced feed utilization and milk production of Damascus goats fed pectin-rich diet

U.Y. Anele[1], H.H. Azzaz[2], A.E. Kholif[2],, H.A. Murad[2], N.E. El-Bordeny[3], H.M. Ebeid[2], N.A. Hassaan[4]

[1]North Carolina Agricultural and Technical State University, Greensboro, NC 27411, USA
[2]Dairy Science Department, National Research Centre, 33 Bohouth St. Dokki, Giza, Egypt
[3]Animal Production Department, Faculty of Agriculture, Ain Shams University, Hadayek Shoubra, Cairo, Egypt
[4]Department of Animal Production, National Research Centre, 33 Bohouth Street, Dokki, Giza, Egypt

Introduction

- Feed cost is the highest variable cost in any ruminant livestock enterprise.
- Agro-byproducts can be used as alternative feeds to reduce feed cost.
- Orange pulp and sugar beet pulp are two important byproducts but have high pectin content.
- Utilization of these byproducts can be improved with the inclusion of pectinase.
- The objective was to evaluate the effects of pectinase supplementation on feed intake and digestion, blood biochemistry, milk production and composition and milk fatty acid profile of Damascus goat fed orange pulp- and sugar beet pulp-based diet.

Materials and Methods

- Thirty lactating Damascus does, weighing 29.1±0.4 kg were randomly assigned to three dietary treatments in a completely randomized design.
- Treatments were diet + no enzyme (control), control + newly developed pectinase at 600 IU/kg DM or control commercial pectinase at 600 IU/kg DM.
- The study was for 12 weeks, comprising of 4 weeks of adaptation to the new ration and enzyme supplementation and 8 weeks of measurements and samples collection.
- We estimated DMI, nutrient intake and digestibility.
- Blood and milk samples were collected and evaluated for blood parameters and milk composition and fatty acid profile.

Results

Table 1 Dry matter intake, nutrient digestibility and nutritive value of the newly developed or commercial pectinase supplemented diets fed to lactating Damascus goats

	Diets[1]			SEM	*P*-value		
	Control	Commercial	New		Diet	Control *vs.* Pectinase	New *vs.* commercial
Intake (g/d)	1177	1146	1169	62.9	0.936	0.801	0.803
Digestibility (g absorbed/kg ingested)							
Dry matter	617^{c}	644^{b}	691^{a}	3.3	<0.001	<0.001	<0.001
Organic matter	647^{c}	670^{b}	714^{a}	4.9	0.002	0.003	0.007
Crude protein	621^{c}	652^{b}	694^{a}	5.8	0.003	0.003	0.002
Ether extract	637^{b}	700^{a}	699^{a}	3.1	<0.001	<0.001	0.820
Non-structural carbohydrates	632^{c}	657^{b}	705^{a}	7.8	0.002	0.002	0.005
Neutral detergent fiber	559^{c}	601^{b}	646^{a}	4.5	<0.001	<0.001	0.004
Acid detergent fiber	561^{c}	611^{b}	661^{a}	3.3	<0.001	<0.001	<0.001
Digestible nutrients and energy value[2]							
Total digestible nutrients (g/kg DM)	660^{c}	688^{b}	722^{a}	4.2	0.001	0.001	0.001
Metabolizable energy (MJ/kg DM)	2.91^{c}	3.03^{b}	3.19^{a}	0.018	0.001	0.001	0.001
Net energy of lactation (MJ/kg DM)	1.50^{c}	1.57^{b}	1.65^{a}	0.010	0.001	0.001	0.001
Digestible crude protein (g/kg DM)	93.5^{c}	97.5^{b}	103.0^{a}	0.75	0.003	0.003	0.002

Means in the same row with different superscripts differ, $P<0.05$.
[1]The control diet based on (per kg DM): 500 g of concentrates feed mixture, 200 g orange silage, 200 g sugar beet pulp and 100 g wheat straw without addition of supplements (Control treatment) or with addition of 600 IU of new pectinase (New treatment)/kg feed daily, or 600 IU of commercial pectinase (Commercial treatment)/kg feed daily.
[2]Calculated according to NRC (2001).

Table 2 Body weight, milk yield and milk composition of lactating Damascus goat fed diets supplemented with the newly developed or commercial pectinase

	Diets[1]			SEM	*P*-value		
	Control	Commercial	New		Diet	Control *vs.* Pectinase	New *vs.* Commercial
Body weight							
Initial BW (kg)	29.4	28.6	29.2	1.69	0.944	0.812	0.814
Final BW (kg)	30.6	30.4	31.5	1.65	0.879	0.889	0.631
Total change (kg)	1.21	1.71	2.29	0.319	0.085	0.059	0.221
Weight change (g/d)	19.3	27.2	36.3	5.06	0.085	0.059	0.221
Milk production (g/d)							
Milk	936c	996b	1085a	13.1	<0.001	<0.001	0.001
Energy corrected milk (ECM)	860c	973b	1085a	31.4	0.003	0.003	0.021
Fat corrected milk (FCM)	859c	946b	1053a	30.5	0.001	0.001	0.023
Total solids	113c	128b	143a	3.6	<0.001	<0.001	0.010
Solids not fat	80.7c	91.4b	101.3a	2.31	<0.001	<0.001	0.007
Fat	32.3b	36.5ab	41.3a	1.91	0.013	0.011	0.097
Protein	29.3b	32.6a	34.9a	0.96	0.002	0.001	0.102
Lactose	44.6c	51.2b	58.0a	1.38	<0.001	<0.001	0.003
Ash	6.91b	7.66ab	8.34a	0.283	0.008	0.006	0.106
Milk energy output (MJ/d)	2.68c	3.04b	3.40a	0.099	0.003	0.003	0.020
Feed (milk) efficiency							
Milk yield/intake	0.80b	0.87a	0.93a	0.048	0.101	0.047	0.413
ECM yield/intake	0.73b	0.85b	0.93a	0.054	0.004	0.007	0.009
FCM yield/intake	0.73b	0.83b	0.90a	0.045	0.002	0.002	0.031
Total saturated fatty acids (SFA)	67.0	65.4	65.2	1.66	0.712	0.433	0.919
Total unsaturated fatty acids (UFA)	30.4	32.5	31.9	1.49	0.614	0.362	0.777
Monounsaturated fatty acids	26.4	28.2	27.5	1.53	0.700	0.456	0.737
Polyunsaturated fatty acids	4.06	4.31	4.44	0.268	0.622	0.380	0.731
Total conjugated linoleic acid[2]	2.85b	3.09a	3.24a	0.011	0.036	0.201	0.585
Omega-6/omega-3 ratio	0.81	0.85	0.88	0.140	0.938	0.755	0.887
UFA/SFA ratio	0.45b	0.50a	0.49a	0.023	0.019	0.045	0.873
Atherogenic index[3]	2.66a	2.43b	2.43b	0.082	0.010	0.040	0.996

Means in the same row with different superscripts differ, $P<0.05$.
[1]The control diet based on (per kg DM): 500 g of concentrates feed mixture, 200 g orange silage, 200 g sugar beet pulp and 100 g wheat straw without addition of supplements (Control treatment) or with addition of 600 IU of new pectinase (New treatment)/kg feed daily, or 600 IU of commercial pectinase (Commercial treatment)/kg feed daily.

- No difference (P>0.05) was noted for feed intake.
- The newly developed pectinase increased (P<0.01) nutrient digestibility, diet nutritive value and milk production efficiency more than the other treatments. .
- Out of all the blood parameters estimated, only serum glucose was affected by the treatments with highest (P=0.025) value noted for the new pectinase.
- The new pectinase increased daily milk production (P<0.005) and the concentrations of milk components compared to the other two treatments.
- Greater feed efficiency calculated as milk yield/intake, ECM yield/intake and FCM yield/intake were observed with the new pectinase followed by the commercial pectinase and the control treatment in that order.
- Treatments did not affect the concentration of individual fatty acids in milk.
- Pectinase inclusion increased (P<0.05) the concentrations of total conjugated linoleic acid and unsaturated/saturated fatty acids ratio.
- Pectinase inclusion also decreased atherogenic index (P=0.01) compared with control treatment.
- The newly developed pectinase performed better than the commercial pectinase.
- Overall, supplementation of the diet of lactating goats with pectinase at 600 IU/kg feed will enhance feed digestion and milk production.
- Results showed the benefit of these byproducts in livestock production in developing economies.