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Effect of deactivation of tannins of pistachio hull by PolyethyleneGlycol on gas production *in vitro*

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Introduction

- Iran is the largest pistachio producer in the world (1). Over the last five years total pistachio by-product production in Iran has been increased at an average rate of about 310,000 tons per year therefore becomes an environmental problem. Pistachio hull (PH) is produced during de-hulling of pistachio nuts soon after harvesting (2).
- Recently, it is shown that PH can be used as a feedstuff in ruminant nutrition (3).
- However, PH contains high level of phenolic compounds and tannins, which can affect its utilization as feedstuff. Tannins can inhibit enzymatic and microbial activity therefore affecting gas production (4, 5).
- Polyethylene glycol (PEG) can form a stable complex with tannins thereby preventing the binding between tannins and proteins. Therefore, PEG has been widely used to reduce the detrimental effect of condensed tannin in ruminant diets (6).

Table1. The biochemical composition of Pistachio hull in Iran

Composition of Pistachio Hull (%)	Mean ± SE
Dry Matter	35.25 ± 0.56
Ash	12.70 ± 0.61
Ether Extract	6.45 ± 0.41
Crude Protein	11.42 ± 0.28
Acid Detergent Fiber	20.58 ± 0.83
Neutral Detergent Fiber	33.26 ± 0.96
Non Fiber Carbohydrate	36.17 ± 0.36
Total Phenol	9.95 ± 0.11
Simple Phenol	3.27 ± 0.10
Tannin	6.68 ± 0.16

Table2. The composition of Fatty acids of Pistachio hull in Iran

Fatty acids composition (g/100g FA)	Mean
C12:0	0.029
C14:0	1.474
C16:0	12.337
C16:1	0.942
C17:0	0.175
C17:1	0.086
C18:0	2.217
C18:1, Cis-9	48.801
C18:2, Cis-9,12	26.938
C18:3, Cis-9,12,15	0.149
C20:0	4.723
C20:1	0.631
C22:0	0.607
C22:1	1.344
C24:0	0.606
C24:1	0.065

Figure 1. The pictures of Pistachio plant (a) and of *Pistachio hull* (b) in Iran

Objectives

The objective of this study was to evaluate effects of deactivation of tannin content of PH by PEG (as a tannin-binding agent) and to investigate its effects on gas production parameters.

Materials and methods

- Treatments included: **Control) 30% alfalfa, 20% straw, and 50% concentration (0.42% tannin), T1) 15% alfalfa, 15% PH, 20% straw and 50% concentration (1.06% tannin), and T2) 30% PH, 20% straw and 50% concentration (1.83% tannin). The treatments were processed with 100 or 200 mg PEG in a 3 × 2 factorial experiment.**
- Gas production was measured (4 replicates) for each treatment. The pressure and volume of gas was recorded before incubation (0) and 2, 4, 6, 8, 12, 24, 36, 48, 72, 96, and 120 hours after incubation.
- Gas production kinetics was estimated using the equation of Ørskov and McDonald (7).

Statistical analysis

- Statistical analysis was performed using the MIXED procedure of SAS ($P < 0.05$).
- The potential and rate of gas production were dependent variables in the model.
- This experiment was performed in a 3 × 2 factorial design including 3 levels of PH and 2 levels of PEG.
- The fixed effects and interaction between PH and PEG were included in the model ($P < 0.05$).
- Treatment means were compared using least square mean (LSD, $P < 0.05$).

Results

- Results showed that the control had significantly higher gas production potential than T1 and T2. Indeed, T2 had significantly higher gas production potential than T1.
- The highest gas production potential was observed in control + 200 mg PEG and the lowest in T1 + 100 and T1 + 200 mg PEG.
- Potential of gas production was affected by the amount of tannin and PEG in the experimental treatments. Indeed, the interaction between PH and PEG on potential of gas production was significant.
- Rate of gas production was not affected by the amount of tannin in the experimental treatments. However it was affected by PEG. Interaction between PH and PEG on rate of gas production was not significant.

Table 3. Effect of different levels of PH with and without PEG on potential and rate of gas production *in vitro*

Items	Gas Production Parameters	
	Potential (ml/g DM)	Rate (ml/h)
Treatments		
Control + 100 mg PEG	215.00	0.073
Control + 200 mg PEG	223.98	0.068
T1 + 100 mg PEG	205.80	0.074
T1 + 200 mg PEG	204.53	0.068
T2 + 100 mg PEG	210.56	0.072
T2 + 200 mg PEG	211.79	0.065
Fixed and Interaction Effects		
PH	0.0001	0.562
PEG	0.0006	0.010
PH × PEG	0.0001	0.900
SEM	0.815	0.002

Discussion

- Tannins inhibited the amount of gas production. PEG reversed this negative effect due to increased availability of nutrients for microorganisms, especially nitrogen availability. Thus, PEG can improve the nutritional value of tannin containing plants (1). There are studies reporting that the tannins reduces extent and rate of gas production in true digestibility experiments and PEG supplementation improves the extent and rate of gas production (6, 8).
- PEG could neutralize tannin negative effects based on gas production technique.

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