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Effect of Heat Treatment on Sesame Cake Protein Degradation

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Abstract: The aim of this study is to estimate the effect of the degree and extend of heat treatment on in situ dry matter and nitrogen disappearance of sesame cake. Sesame cake was heated in autoclave at 140^0C, 150^0C and 160^0C for 1, 2 and 3 hours each, accordingly the treatment were T2:1, T2:2, T2:3, T3:1, T3:2, T3:3, T4:1, T4:2 and T4:3 respectively, and the untreated sesame cake represented control (T1). The extent of dry matter DM and crude protein CP degradability was determined by insitu polyester bag technique. The individual samples were incubated in the rumen for 3, 6, 12, 24,36 and 48hrs, using three fistulated adult female goats maintained on basal diet of sorghum (abu70).Untreated sesame cake was significantly ($p<0.001$) highly degradable than the heat treated sesame cake. Heat treatment induced protein protection by forming insoluble protein. The maximum reduction of CP degradability as average reported inT3 followed by T4 and T2 respectively.

Key wards: Heat treatment, CP degradability, Sesame cake

INTRODUCTION

The rumen microbial protease and deaminase rapidly degrade protein and amino acid, which are soluble in the rumen liquid phase.

The ruminant dietary proteins are degraded by microbial protease in the rumen to amino acids which furtherly are degraded by deamination to organic acids, ammonia and carbon dioxide. Because protein sources vary in their solubility, the degree of degradation in the rumen is variable. High degradability of protein lead to excessive amount of ammonia which is lost in urine in form of urea[7].

Methods of decreasing protein and amino acids degradation in the rumen include heat treatment, chemical treatment, encapsulation, use of amino acid analogs and esophageal groove closure, regarding that procedures do not interfere with ruminal metabolism or post ruminal digestion because over protected proteins are neither fermented in the rumen nor digested in the small intestine.

A feasible approach to maximize the benefit of protein in ruminant nutrition would be the utilization of non protein nitrogen for rumen protein production, maximization of rumen bypass of dietary protein and supplementation with rumen non degradable amino acids.

The objective of this study is to estimate the effect of the degree and the extend of heat treatment on insitu dry matter and nitrogen disappearance of sesame cake.

MATERIALS AND METHODS

The experimental feed used was sesame cake. Untreated sesame cake represent control (T1)
heated at 140 ^{0}C,

- for 1h (T2.1)
- for 2hs (T2.2)
- for 3hs (T2.3)
- heated at150 ^{0}C
- for 1h (T3.1)
- for 2hs (T3.2)
- for 3hs (T3.3)
- heated fore 160 ^{0}C
- for 1h (T4.1)
- for 2hs (T4.2)
- for 3hs (T4.3)

Degradability Study: The extent of dry matter and nitrogen disappearance will be determined by insitu polyester bag technique according to Mehrez and Orskov. Samples were incubated in the rumen for 3, 6, 12, 24, 36 and 48 using three fistulated adult female goats maintained on basal diet of sorghum (abu70)

The percentage of dry matter and nitrogen loss were calculated as follows

$$\frac{\text{Wt. Of incubated sample}}{\text{-wt. Of residue after incubation}} \quad X100$$
$$\text{Wt. Of incubated sample}$$

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The dry matter disappearance at zero time (soluble fraction) was estimated as washing loss of samples weighed into nylon bag and rinsed through running tap water.

Degradation kinetics described by curve- linear regression of dry matter and crude protein lost from the bag with time Orskov and McDonald.

- $P= a + b (1- exp^{-ct}) \ldots 1$

Where:

- p = potential degradability
- t= incubation time
- a = axis intercept at time zero represents soluble and complete degradable substrate that is rapidly washed out of the bag.
- b = the difference between the intercept (a) and the asymptote, represents the insoluble but potentially degradable
- c = rate constant of b function, a, b and c are constant fitted by an interactive least squares procedure.
- Effective degradability $= \frac{a + bc}{c+k}$

where:

- a, b, and c are constants as defined in equation 1
- k = rumen small particles out flow rate

The graphs were plotted by fitted values of crude protein disappearance percentage against time of incubation in hours to form a curve.

Statistical Analysis: Data were subjected to analysis of variance according to Steel and Torrie[6].The comparison among means was analyzed by the least significant difference using LSD procedure of the Statisticx.

RESULTS AND DISCUSSIONS

Results: Chemical composition in term of CP and OM of treated and untreated sesame cake were shown in Table (1). There was no change in chemical composition due to heat treatment.

CP degradability was shown in Table (2). The findings indicated that the untreated sesame cake was significantly ($p<0.001$) highly degradable than the heat treated sesame cake. The soluble fraction (a) of crude protein was significantly ($p< 0.001$) decreased due to heat treatment. At the same time the rate of degradation was reduced similarly the effective degradability (ED) at the three levels of rumen out flow rate (K) (0.02, 0.05 and 0.08) were lower than control values table (2).

Table 1: Chemical Composition of heat treated and untreated sesame cake.

	CP %	OM%
T1	35,61	83,52
T2:1	38,24	83,66
T2:2	37.98	83.09
T2:3	37.28	83.57
T3:1	37.1	83.14
T3:2	36.75	83.03
T3:3	36.58	83.15
T4:1	39.2	84.25
T4:2	38.68	84.05
T4:3	34.69	83.16

T1: Un heated
T2:1: Heated 140°C at 1 hour
T2:2: Heated 140°C at 2 hours
T2:3: Heated 140°C at 3 hours
T3:1: Heated 150°C at 1 hour
T3:2: Heated 150°C at 2
T3:3: Heated 150°C at 3
T4:1: Heated 160°C at 1 hour
T4:2: Heated 160°C at 2 hours
T4:3: Heated 160°C at 3 hours

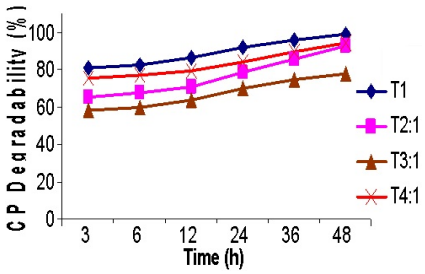

Fig. 1: Rumen degradability protein for 1 hour

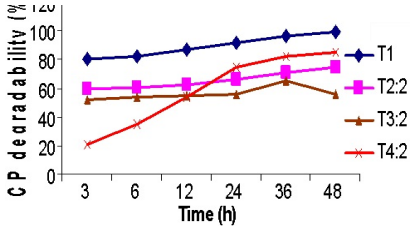

Fig. 2: Rumen degradability protein for 2 hours

In situ DM degradability for treated and untreated sesame cake was presented in table (3) the results showed the same trend of crude protein degradability. The soluble fraction (a) was high value 71.37%, In contrast insoluble fraction (b) was low 26.8%. ED of sesame cake at the three levels of rumen out flow rate was low value. The maximum reduction in rumen degradability as average of the three times was observed in T3 followed by T4 and T2 respectively, Fig. (1), (2) and (3).

Table 2: Insitu crude protein CP degradability of treated and untreated Sesame cake.

	a	b	c	ED0.02	ED0,05	ED0,08
T1	71.37^{a}	26.8^{c}	.07^{ab}	92.12^{a}	87.23^{a}	84.23^{a}
T2:1	49.6^{d}	61.33^{a}	.006^{bcd}	90.03^{a}	77.17^{b}	72.4^{b}
T2:2	57.03^{cd}	48.73^{abc}	.001^{cd}	75.87^{bc}	64.57^{c}	61.73^{cd}
T2:3	54.23^{cd}	51.47^{ab}	.023^{bcd}	61.8^{de}	63.1^{c}	62.53^{c}
T3:1	55.7^{cd}	34.23^{bc}	.035^{bc}	75.87^{b}	67.6^{c}	65.17^{c}
T3:2	51.13^{d}	41.9^{abc}	.046^{bc}	56.13^{de}	54.9^{d}	54.33^{e}
T3:3	50.9^{d}	37.2^{bc}	.04^{bc}	57.23^{de}	55.4^{d}	54.3^{e}
T4:1	69.33^{ab}	39.2^{abc}	.001^{cd}	92.27^{a}	81.5^{ab}	78.07^{b}
T4:2	61.5^{c}	38^{bc}	.13^{a}	65.5^{cd}	63.07^{c}	62.5^{c}
T4:3	56.0^{cd}	52.4^{ab}	-.04^{d}	53.9^{e}	55.97^{d}	56.1^{de}
SE	2.77	7.8	.025	3.36	1.94	1.94

Columns having different superscripts significantly (p<.001) differ

a: Soluble fraction of feed

b: Potential degradable fraction

c: Rate of degradation of fraction b (h-1);

ED: Effective rumen degradability calculated at out flow rate K = 0,02, 0,05, and 0,08 h-1.

Table 3: Insitu dry matter DM degradability of treated and untreated Sesame cake

	a	b	c	ED0.02	ED0,05	ED0,08
T1	47.83^{a}	53.93^{c}	.045^{ab}	81.7^{a}	70.4^{a}	64.9^{a}
T2:1	20.43^{bc}	77.66^{ab}	.003^{b}	87.33^{a}	50.03^{c}	39.4^{c}
T2:2	15.23^{cd}	84.0^{ab}	.001^{b}	51.9^{b}	30.56^{e}	25.06^{e}
T2:3	10.73^{d}	86.0^{a}	.12^{a}	29.56^{c}	25.83^{ef}	23.66^{e}
T3:1	12.77^{cd}	35.9^{d}	.058^{ab}	52.97^{b}	37.06^{d}	31.73^{d}
T3:2	9.63^{d}	18.26^{e}	.06^{ab}	22.1^{c}	18.73^{g}	17.26^{fg}
T3:3	9.4^{d}	22.53^{de}	.115^{a}	22.5^{c}	18.13^{g}	17.06^{g}
T4:1	23.9^{b}	70.39^{b}	.02^{ab}	77.67^{a}	61.6^{b}	55.17^{b}
T4:2	14.5^{cd}	14.53^{e}	.093^{ab}	26.46^{c}	23.96^{fg}	22.2^{ef}
T4:3	8.13^{d}	18.6^{e}	.07^{ab}	21.83^{c}	18.13^{g}	16.23^{g}
SE	2.76	4.64	.035	6.02	2.15	1.69

Columns having different superscripts significantly (p<.001) differ

a: Soluble fraction

b: Potential degradable fraction

c: Rate of degradation of fraction b (h-1);

ED: Effective rumen degradability calculated at out flow rate K = 0,02, 0,05, and 0,08 h-1.

Discussion: Heat treatment had no effect on chemical composition in term of CP and OM of sesame cake. This result is in agreement with result reported by Hossain *et al.,*[2]. Sesame cake had higher degradable protein when compared to another source of protein. The fermentation characteristics (a), (b) and (c) values were 77.3, 26.8 and 0.07 respectively. These values to some extend were higher particularly fraction (a) and the fermentation rate fraction (c) than findings obtained by Wood *et al.,* how found 39.23, 54.04 and 0.02 respectively in rapeseed meal. Because of the higher soluble fraction (a), sesame cake protein must be protected either by heat or chemical treatment. Heat treatment induced protein protection by forming insoluble protein, Hossain *et al.,*[2] therefore in this result the soluble fraction (a) and the degradable

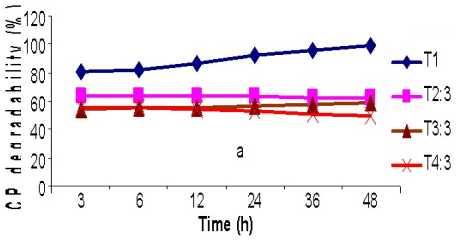

Fig. 3: Rumen degradability protein for 3 hours

fraction (b) were significantly ($p<0.001$) decreased and increased respectively due to heat treatment. this result agreed by Scharad[4]. The rate of fermentation fraction (c) values, and the true degradability calculated for

three levels of rumen out flow rate (0.02, 0.05 and 0.08) were lower in heat treated sesame cake than the untreated one,this result is inconsistent with findings of Broderick *et al.,*[1] and Scharad[4]. In this experiment heat treatment caused protein protection, by reducing rumen degradation, this findings supported by Hossain *et al.,*[2] and Kari *et al.,*[3] who found similarly that heat treatment reduce rumen degradation. Effective degradability (ED) on 150°C (T3) at the three times 1, 2 and 3 hours, were significantly ($p<0.001$) lower than the other treatments, this observation were agreed with Kari *et al.,*[3]. The best protections were observed at 150°C for 1, 2 and 3 hours, respectively figure 1, 2 and 3. These findings are in agreement with Yang *et al.,*[9], Broderick *et al.,*[1] and Vishnu *et al.,*[8].

Conclusion: This study concluded that the heat treatment caused protein protection by reducing the soluble fraction (a) resulted in low effective degradability. The best protection occurred at 150°C for the three times 1, 2 and 3 hours, but more investigation need to determine whether the protected protein is digestible or not.

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