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Effects of Replacing Wheat Bran with Dried Ground Citrus Peel in Urea Molasses Block for Feeding Lactating Dairy Cows

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ABSTRACT

For the research trial a total of twelve lactating dairy *Holstein Friesian* cows were randomly selected and divided into 4 groups as; T-0, T-25, T-50 and T-100 supplemented with UMB having 0%, 25%, 50% and 100% substitution of wheat bran with citrus peel, respectively. Daily total mix ration (TMR), UMB and total feed intake on fresh basis was not significantly (p>0.05) effected. However, numerically maximum daily TMR intake was observed in T-100 followed by T-50 and T-25. Maximum daily total feed intake was recorded for group T-100. On dry matter (DM) basis TMR, UMB and total DM intake was also not significantly (p>0.05) effected. Maximum value for TMR and total feed intake was observed in T-100 while UMB intake on DM basis was observed high in group T-50 and lower in group T-100. The milk yield was not significantly (p>0.05) effected. But maximum increase in total milk yield was observed in group T-50 and T-100. No significant effect was found on milk components in all the treated groups. Mean UMB cost per cow was significantly higher in T-0 while lowest UMB cost was recorded in group T-100. Gross return and income over UMB cost was not statistically different. Group T-100 had high income over UMB cost among all the groups followed by T-50. From the outcome of present study, it is concluded on economical basis that citrus peel can replace 100% of wheat bran in urea molasses block for feeding to lactating dairy cows.

Keywords: *Citrus, Molasses block, Wheat bran, Cows*

1. INTRODUCTION

Livestock sector in Pakistan plays a vital part in agriculture advancement and adds a lot to the national economy. It has an important role in poverty alleviation. Livestock contributes approximately 55.4 percent to the agricultural value added and 11.9 percent to national GDP during 2011-12. Gross value added of the livestock sector at constant factor cost has increased from Rs. 672 billion (2010-11) to Rs. 700 billion (2011-12); showing an increase of 4.0 percent as compared to previous year (Economic survey of Pakistan, 2011-12).

Many of the south-eastern countries are deficit in animal feed resources. In progressing countries production is mainly reliant on stringy feeds mostly yield remains and pasture that are insufficient in nitrogen, minerals and vitamins. Oil cakes being protein supplement are available at high cost. Therefore efforts are needed to use unconventional feed stuffs to overcome the shortage of animal feed resources. Using blocks to present nitrogen, minerals and vitamins low in fibrous feeds is paramount. These measures result in better output in provision of improved milk and meat fabrication and high reproductive competence (FAO, 2011).

Blocks engenderment on little price and unconventional feed commodities that do not fight with individual food or are misused as such should be one of the important areas for potential employment. Areas scarce in certain resources should be correctly mapped and chunks should be nascented to get together the need of the precise mineral deposits (FAO, 2011). In rising African and Asian countries it is commonly known that feed resources which are accessible in many circumstances are unused and enervated. These feedstuffs have abeyant value, but their use has been ignored (Sonaiya, 1995).

A chief derivative of wheat milling, wheat bran is utilized mainly in livestock and poultry feed. Fine and coarse bran are the resultants, resulting from the process of milling. A high proportion of crude protein exists in fine wheat (13%) and lowers in coarse wheat bran. Poultry ration has high amount of fine wheat bran and cattle feed has coarse bran.

Animal's diets are based on fibrous feeds like crop residues and completely developed pastures, which are low in protein, reserves and vitamins and are less edible. These factors influence feed consumption and reduce yield. Feeding UMB can speed up rubbery feed digestibility up to 20% and nutrient ingestion is improved from 25 to 30%. Addition of vitamins, minerals, medicines, etc is more beneficent, which is a appropriate means to stock up molasses and presented to animals. They are geared up with ease and utilized in villages, can be used as a source of income for farmers as well (Verma *et al.*, 2011).

Sweet flavor of molasses enhance block consumption. In the urea block wheat bran acts as protein, energy source and binding agent. Non protein nitrogen source is Urea. To control utilization and to ensure mineral provision salt is added. Finely chopped straw, bagass, grinded foliages and peels of leguminous shrubs and fruits can be used as alternate for wheat bran (Verma *et al.*, 2011). In Pakistan being a larger producer of citrus fruits, their peels are ravaged and remaining is wasted. Therefore the present study was conducted with the possibility to utilize citrus peel as an alternate of wheat bran with the given aims.

Objectives:

1. To examine citrus rind insertion as ersatz of wheat bran in UMB on, feed, UMB and intake of dry matter in dairy cows.
2. Investigating substitution upshot of wheat bran with citrus peel on milk production
3. To analyze the inclusion impact of citrus casing as a surrogate of wheat bran on milk composition.
4. To calculate the economics of experimental rations

2. MATERIALS AND METHODS

Current research was carried out at University Dairy Farm, The University of Agriculture, Peshawar with the aim to investigate the impact of wheat bran proxy with different levels of citrus peels in UMB for feeding to lactating ***HF*** cows.

2.1 Experimental design

A total of twelve animals were randomly selected and divided into 4 groups as; T-0, T-25, T-50 and T-100 supplemented with UMB having 0, 25, 50 and 100% restoration respectively. Each group was divided into three replicates of one animal each. Total mix ration (TMR) was offered to all the groups twice a day and provision of clean drinking water was made on hand to cows round the clock. Each experimental animal was cured for ecto and endo parasites. Total experimental period was 20 days. Ten days were adaptability span and data was gathered in the last ten days (table 1).

Table 1. Proposed layout for experiment

Group	Replacement level (%) of wheat bran with citrus peel in UMB	Replicates		
		R1	R2	R3
T-0	0 (control)	1	1	1
T-25	25	1	1	1
T-50	50	1	1	1
T-100	100	1	1	1

UMB = Represents urea molasses block; 0-100 = 0 to 100% replacement of wheat bran with citrus peel

2.2 Materials required

Preparation of citrus peels for inclusion in urea molasses block

Citrus peels were collected from local markets and were sun dried. After drying, citrus peels were grinded (1mm) with the help of grinder (Thomas Wiley, Laboratory Mill Model 4 Thomas Scientific USA) at the Department of Animal Nutrition, The University of Agriculture, Peshawar.

2.3 Proximate analysis

Citrus peel sample was subjected to proximate analysis before preparation of urea molasses block and afterwards UMB samples were tested according to the method of Association of Official Analytical Chemists (AOAC, 2005) in the laboratory of Animal Nutrition and Poultry Nutrition, Directorate of Livestock Research and Development, Khyber Pakhtunkhwa, Peshawar.

Table 2. Proximate Analysis of Citrus Peel

Sample	DM%	Ash%	C.Protein%	C.Fiber%
Citrus Peel	90.94	5.67	8.00	13.00

Table 3. Proximate Analysis of UMB

Sample	DM%	Ash%	C.Protein%	C.Fiber%
UMB T_0	68.90	29.12	39.01	6.85
UMB T_{25}	68.47	24.10	37.98	6.83
UMB T_{50}	73.41	32.35	36.48	5.69
UMB T_{100}	64.81	32.20	38.49	6.22

2.4 Feeding trial

All the experimental animals were grouped as T-0, T-25, T-50 and T-100. Total mix ration was contrived as per readiness of roughages and concentrates and was fed as a basal diet to all the groups. Urea molasses blocks having 0%, 25%, 50% and 100% replacement of wheat bran with citrus peels were supplemented to group T-0, T-25, T-50 and T-100, respectively. Urea molasses blocks (2.5-3kg) were kept in front of each animal for licking during the experimental period. At the end of each day UMB was weighed to find out the UMB intake.

Formulation of urea molasses block (UMB)

Four types of urea molasses blocks were formulated (Table 4)

Table 4. UMB Composition

Ingredients	UMB1 (0%)	UMB2 (25%)	UMB3 (50%)	UMB4 (100%)
Molasses	45	45	45	45
Urea	7	7.25	7.50	7.75
Wheat bran	30	22.50	15	0
Citrus peel	0	7.50	15	30
Clay	7	6.75	6.50	6.25
Lime stone	5	5	5	5
Salt	3	3	3	3
DCP	3	3	3	3
Total	100	100	100	100

2.5 Data collection

Data was collected for the following parameters.

Feed intake and Urea Molasses Block intake

A known quantity of feed (TMR) was offered twice a day. The feed refused was weighed and feed intake for each animal throughout the experimental period was calculated as follows:

Feed intake = Feed offered- Feed refused

The urea-molasses blocks were weighed each morning and the daily intake of the blocks was calculated as follows:

UMB intake = UMB offered- UMB refused

Dry matter intake

Dry matter intake (DMI) was calculated as percent dry matter in feed consumed in all the experimental groups as follows:

DMI = % DM in feed consumed × feed consumed

e.g. if berseem DM is 18% and a dairy cows is offered 20 kg so its DMI will be 3.6 kg

$$\frac{18}{10} * 20 = 3.6$$

Milk Yield (L)

Milk yield for each group was determined by recording the daily milk production (morning and evening) of each animal. The total milk yield (10 days) for each group was calculated by summing up the daily milk yield of the respective group. The total milk yield of all the groups were compared.

Milk Composition

Milk sample (100 ml) was taken from each animal for determination of Milk fats (%), solids not fats (SNF), protein (%), lactose (%) contents with the help of Lactoscane (auto analyzer machine) at Veterinary Research Institute, Peshawar.

Economics

Comparative economics of all the groups was calculated as follows:

UMB cost per animal = UMB consumed × cost per unit UMB

Gross return = Price per unit of milk in the market × milk increase per day

Income over UMB cost = Gross return – UMB cost per animal

Data analysis

The analyses of the recorded data was carried out through standard procedure of analysis of variance (ANOVA) in completely randomized design (CRD) and means were compared by least significant difference (LSD) (Steel and Torrie, 1997). The statistical package SAS (2002) was applied to complete the data analysis.

Statistical model: $Yij = \mu + \alpha j + \varepsilon_{ij}$

Where

Yij= yield or response variable subjected to ith animal and jth treatment, yield comprises feed intake, DMI, UMB intake, milk production and composition and economics

μ= Population mean, common to all observations.

αj= Treatment effect. Treatment comprises replacement of 0, 25, 50 and 100% wheat bran with citrus peel.

ε_{ij} is treatment error normally distributed with zero mean and constant varience. δ^2 i.e Eij ~N (0- δ^2).

3. RESULTS

Results of the present study are given as follows:

3.1 Feed intake

Mean data on daily total mix ration intake (TMR), UMB intake and total feed intake per lactating dairy cow are given in Table 5. TMR intake was not significantly (p>0.05) effected. However, numerically maximum daily TMR intake was observed in T-100 (29.3kg) followed by T-50, T-25 and lower in control group T-0 (27.8kg). Urea molasses block intake was not effected significantly (p>0.05) (Appendix. 2) but lower mean value for UMB intake (0.43kg) was observed in group T-100 having 100% replacement of wheat bran with citrus peel respectively. Total feed intake was also not affected significantly (Appendix.3). Maximum total feed intake was recorded for group T-100 (29.7kg) followed by T-50, T-25 and lower (28.2kg) in control group T-0.

Table 5. Mean total mix ration and urea molasses block intake (kg) per day on fresh basis in dairy cows

Group	Total mix ration intake		UMB intake		Total feed intake	
	Mean±SE	CV	Mean±SE	CV	Mean±SE	CV
T-0	27.83±0.440	2.03	0.443±0.06	4.96	28.27±0.439	2.02
T-25	28.70±0.300		0.440±0.03		29.14±0.330	
T-50	29.00±0.577		0.440±0.015		29.44±0.571	
T-100	29.30±0.351		0.430±0.005		29.73±0.350	
P-value	0.1428		0.8044		0.1519	

T= Treatment; 0-100% replacement of wheat bran with citrus peel.

3.2 Dry matter intake (DMI)

Data regarding daily mean intake of TMR and UMB on dry matter basis per cattle are presented in Table 6. Total mix ration intake on DM basis was not significantly (p>0.05) effected in dairy cows. Maximum value for TMR intake was observed in T-100 (16.11kg) followed by T-50 (15.95kg), T-25 (15.65kg) and lower (15.30kg) in control group. Urea molasses block intake on DM basis was not significantly affected (Appendix. 5) but was observed high (0.318kg) in group T-50 and lower in group T-100 (0.278kg). The total dry matter intake (DMI) was not effected significantly (p>0.05) (Appendix 6). Numerical value for daily DMI was found higher in group T-100 which had 100% replacement of wheat bran with citrus peel followed by T-50 and T-25. Lower value was recorded for the control group (T-0).

Table 6. Consequence of substitution of wheat bran on daily total mix ration and urea molasses block intake (kg) on dry matter basis in dairy cows

Group	Total mix ration		UMB		Total DMI	
	Mean±SE	CV	Mean±SE	CV	Mean±SE	CV
T-0	15.30±0.241	1.89	0.305±0.004	5.04	15.61±.240	1.83
T-25	15.65±0.159		0.300±0.007		15.95±.151	
T-50	15.95±0.317		0.318±0.013		16.268±.315	
T-100	16.11±0.194		0.278±0.003		16.392±.193	
P-value	0.0622		0.0880		0.0626	

T= Treatment; 0-100% replacement of wheat bran with citrus peel.

3.3 Milk yield (liter)

Data on mean total increase in milk yield per day are showed in Table 7. Substitution did not affect the milk yield significantly (p>0.05). However, numerically increase in total milk yield was observed high in group T-50 and T-100. Maximum increase was recorded for group T-50 (1.53 lit/day) followed by T-100 (1.52 lit). Minimum increase in milk yield was observed in group T-0.

Table 7. Effect on daily milk yield (lit) per animal in dairy cows.

Group	Increase in milk yield/day	
	Mean±SE	CV
T-0	1.30±**0.**152	11.36
T-25	1.40±**0.0**57	
T-50	1.53±**0.0**33	
T-100	1.52±**0.0**26	
P-value	0.3315	

T= Treatment; 0-100% replacement of wheat bran with citrus peel.

3.4 Milk Composition

Mean data on milk fat (%) are given in table 8. Fat percentage in the milk was not notably (p>0.05) effected. Slightly higher percentage of fat was observed in control group T-0 (4.22) followed by T-50 and T-100 (4.20). Protein content was not affected significantly but maximum value of 3.45% was recorded for T-50 followed by 3.30% for T-100. Values of 3.16% and 3.27% protein were observed in T-25 and T-0 respectively (Table 8). Lactose content of the milk was not statistically different (p>0.05) among the groups . Values of 3.84, 3.83, 3.84 and 3.81% lactose were found in group T-0, T-25, T-50 and T-100 respectively. No significant effect was found on solid not fat (SNF %) (Table 8). However, the cows fed with UMB which having replacement of wheat bran with citrus peel had high SNF contents as compared to control group T-0. SNF of 7.27, 7.19 and 7.26% was observed in group T-25, T-50 and T-100 respectively

Table 8. Milk Composition

Group	Fat Mean±SE	Protein Mean±SE	Lactose Mean±SE	SNF Mean±SE
T-0	4.22±0.075	3.27 ± 0.084	3.84±0.026	7.20±0.059
T-25	4.08±0.033	3.16 ± 0.107	3.83±8.819	7.27±0.012
T-50	4.20±0.078	3.45 ± 0.213	3.84±0.0318	7.19±0.054
T-100	4.20±0.089	3.30 ± 0.092	3.81±8.81	7.26±0.029
P-value	0.6236	0.6320	0.8319	0.4886

T= Treatment; 0-100% replacement of wheat bran with citrus peel

3.5 Economics

Cost was significantly affected (p<0.05) (Table 9). Mean UMB cost per animal was observed high in T-0 (9.33) which had no replacement of wheat bran with citrus peel. Lowest UMB cost was recorded in-group T-100 (7.09) followed by T-25 (8.15) and T-50 (8.77). Gross return was not statistically different among all the groups but numerical high value of Rs. 92 was found in group T-50 followed by 91.60 in T-100.Similarly, total income over UMB cost was not significantly (p>0.05) effected by the UMB composition in all the treated groups. T-100 had high income over UMB cost (84.50) among all the groups followed by 83.22, which was observed in T-50. Lowest value for income over UMB cost was recorded in-group T-0 (68.66).

Table 9. UMB cost (Rs), gross return (Rs) and income over UMB cost

Group	UMB Cost		Gross return		Income over UMB cost	
	Mean±SE	CV	Mean±SE	CV	Mean±SE	CV
T-0	9.336^{a}±0.140	4.90	78.00±20.352	11.36	68..66±9.212	12.70
T-25	8.155^{b}±0.349		84.00±3.464		75.84±3.742	
T-50	8.773^{ab}±0.230		92.00± 2.00		83.22 ±1.804	
T-100	7.095^{c} ±0.095		91.60 ±1.60		84.50±1.518	
P-value	0.0026		0.3315		0.2766	

T= Treatment; 0-100% replacement of wheat bran with citrus peel. Means with different superscripts in the same column are significantly different at p<0.05.

Table 10. Cost of Urea molasses block/ kg having citrus peel as replacement of wheat bran

cost of 1kg UMB					
Ingredient	**Cost/kg**	**T- 0**	**T-25**	**T-50**	**T-100**
Mollases	18	8.1	8.1	8.1	8.1
Urea	40	2.8	2.9	3	3.1
Wheat bran	22	6.6	4.95	3.30	0
lime stone	12	0.6	0.6	0.6	0.6
Salt	30	0.9	0.9	0.9	0.9
DCP	50	1.5	1.5	1.5	1.5
Clay	8	0.56	0.54	0.52	0.50
Citrus peel	6	0	0.45	0.90	1.8
Total		21.06	19.94	18.82	16.50

Note: 6 Rs of citrus peel includes its transportation and processing cost.

4. DISCUSSION

Results of the present study on the possibility of replacement of wheat bran with dried citrus peels in urea molasses block (UMB) are discussed as follows:

4.1 Feed Intake

In the whole experiment total feed intake, total mix ration and UMB intake on fresh as well as on dry matter basis was not statistically different (p>0.05). However, cows fed with UMB that had citrus peels showed higher UMB intake as well as feed intake. This tendency of feed intake and UMB intake may be due high palatability of citrus peel as compared to other ingredients or laxitative effect of citrus peel (Harb, 1971). Jong-Kyu *et al*. (1996) reported that replacing 30% of concentrates with dried citrus pulp did not affect milk yield and fat proportion of milk. Many other factors that include hardness of block, softness of block, level of urea and type of animal may affect intake of block as well as feed (Sudana and Leng, 1986). The average block consumption ranged from 420 to 440 grams per day.

UMB supplementation increase feed intake and feed conversion ratio could be mainly due to the high amount of energy and minerals in UMB which stimulate rumen microbes and to digest crude fiber. Molasses is a concentrated sugar and also contains trace minerals, vitamins and rich in potassium and sulphur (Sudana and Leng, 1986). This stimulates the animal to increase feed intake which cause high nutrient intake and in turn gives high production. UMB provides fermentable nitrogen, readily available carbohydrates and minerals which helps in the development of cellulolytic microbes and ultimately results in superior consumption of roughages (Leng, 1984). Similar to our findings Akter *et al.* (2004) also reported that UMB supplementation did not influence feed intake significantly.

Furthermore they also reported that intake of UMB also depends on type of UMB i.e. hardness or softness of blocks. It also increases palatability when supplemented with low quality roughages thus enhances feed intake. Molasses make the urea palatable which is bitter and provide energy to assist the digestion. Urea molasses block is an outstanding way to provide gamely degradable protein and fermentable energy to ruminants thus increases intake of dry and low quality forage as well as increases digestibility.

Micro-organisms in the rumen convert feed into compounds which are used by the animals for body requirements. Micro-organisms in the rumen use ammonia to make microbial proteins. Urea is converted into ammonia by the micro flora in the rumen thus urea is a non-protein nitrogen source for the ruminants thus diets such as dry and low quality roughages which are often deficient in crude protein thus urea has value equal to protein for ruminants. Low nitrogen in the diet decrease microbial protein synthesis which are required for the maintenance, growth and production of an animal (Kumar, 2010).

The increase in dry matter intake due to UMB is due to ammonia and fermentable carbohydrates which increase the bustle of rumen micro flora and also enhance fermentation of roughages which may increase the eating of roughages (Leng *et al*., 1991; Sudhaker *et al*., 2002). Santra and Karim (2009) also reported that increase level of UMB in ruminants diets increase intake of dry matter due to proliferation of micro flora population. Faftine and Zanetti (2010) reported increase ingestion of maize stover due to UMB supplementation as a result of increased activity of cellulotic micro flora of rumen which help in degradation and passage rate of digesta. Feeding UMB with balanced energy and protein ratio optimizes rumen ecosystem which increase rate of fiber digestion and rumen outflow and thus basal feed intake is also stimulated (Leng *et al*., 1991).

It must be kept in mind that during dietary supplementation of UMMB, dairy cows response to an increased nutrient supply depends on several factors, such as the cows' genetic potential, stage of lactation and the related feeding level, feed quality and climate (Wiktorsson 1979).

4.2 Milk yield

Milk production was not significantly affected (p>0.05). Increase in milk yield per day was observed high in group T-50 and T-100. Maximum increase was recorded for group T-50 (1.53 Liters) followed by T-100 (1.52). In all the groups milk yield was increased by UMB supplementation but high increase was in citrus peel UMB supplemented groups. The increase in milk production was 17.43% as compared to the control. Akter *et al.* (2004) reported increase in milk production in cows consuming 250 g UMMB daily. Brar and Nanda (2002) also reported similar results. Similarly Kunju (1988) reported improvement in the milk yield due to UMB supplementation in low yielding cattle’s.

Wanapat *et al*. (1999) also reported that UMB feeding has significant effect on milk yield because it provides carbohydrates and nitrogen to microbes of the rumen which in turn improves the digestibility of the other nutrients. Bandla and Gupta (1997) reported marginal increase in milk yield due to UMB supplementation. According to Hendratno (1997) UMB significantly increase milk yield and improves body condition scores due to increase digestibility of feed. The increase milk production is due to increase digestibility of the feed and feed intake and the availability of readily available fermentable carbohydrates and minerals. Uddin *et al*. (2002) and Alam *et al*. (2006) also reported increased milk yield due to UMB supplementation in buffaloes and crossbred cows.

4.3 Milk composition

In this experiment concentration of milk components was not affected. None of the milk content was increase or decrease significantly. Contrary to these findings Kunju (1988) reported that protein and SNF contents were significantly increased with increase of UMB supplementation. The results regarding change in milk composition depends on many factors of which composition of the diet is of most importance. The feed which contain more protein and fat will increase the fat and protein in milk (Khan *et al*., 1990). But contrary to these findings some authors reported that feeding had no significant effect on milk composition (Ahmad *et al*., 1982; Yan *et al*., 1997).

Sudhaker *et al*. (2002) and Upreti *et al*. (2010) reported that the well balanced fermentable nitrogen and energy of UMB supports the activity of rumen micro flora which increased fiber digestibility and the result is high ruminal acetic acid fermentation which in turn increases fat content in milk. Khan et al. (2007) reported that UMB supplementation had no effect on milk protein in cows. Sahoo *et al*. (2009) reported that milk protein was significantly increased with UMB supplementation in local dairy cows. Misra *et al*. (2006) also showed no improvement in protein content of the milk.

4.4 Economics

The importance of urea molasses block can be revealed from the fact that it reduces the cost of feed for milk production. UMB having 100% replacement of wheat bran with citrus peel was more economical in terms of UMB cost and income over UMB cost although gross return was a little higher for UMB which had 50% citrus peel. Only the processing cost of citrus peel was included and there was no significant effect observed on milk production. Gross return was 17.43% high at 100% replacement as compared to control and percent increase at 100% replacement in income over UMB cost was 23.07 as compared to control. Therefore based on these findings UMB-100 was more economical as compared to all other groups. These findings are similar to the findings of Bandla and Gupta (1997) who also reported increase income due to increase production of milk of UMB supplemented cows.

5. CONCLUSIONS AND RECOMMENDATIONS

Replacement of wheat bran with citrus peel in UMB at the level of 100 % showed high feed intake in lactating dairy cows and urea molasses block intake was high at 25% and 50% replacement. Maximum increase in milk yield per day in dairy cows was found at 50 and 100% replacement of wheat bran with citrus peel in UMB. No changes were determined in milk components at any level of replacement of wheat bran with citrus peel in UMB. Wheat bran replacement with citrus peel at a level of 100% in UMB fed to lactating dairy cows was more economical in terms of UMB cost and income over UMB cost. Citrus peels may be used to replace 100% wheat bran in UMB for feeding to dairy cows**.** It is further recommended to investigate the potential of citrus peel in UMB for feeding to small ruminants and in fattening animals.

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