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Respondents Evolution of the Effect of Grazing on Bt-cotton Crop Residues by Ruminants on Health and Milk Characteristics in Gezira State, Sudan

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Abstract **– The introduction of Bt cotton in Sudan enhanced cotton productivity and restored cotton as a main cash crop. Due to fear among animal owners from grazing on Bt-cotton crop residues an investigation in the form of questionnaire was conducted in two sites (South Gezira locality and Um-Algura locality) to know the effect of grazing on Bt-cotton crop residues (Bt-CCR) on animal health and milk characteristic. 50 questionnaires to investigate the effect of grazing on Bt-CCR on animal health and milk characteristic were distributed to each of the two localities. There was an agreement between the respondents in both sites on that, Bt-CCR had some effects on: Milk production, the color of milk, the taste of milk, the impact on animal health and the milk coagulation. There were some symptoms due to feeding on Bt CCR (if it is cultivated) which included: Diarrhea alone, Diarrhea with mucus, Diarrhea and nasal discharge and Diarrhea and bloat. The most animals affected were cows and sheep. It is recommended that, more investigations are needed to elucidate the reasons of those effects, before taking a decision to prohibit the grazing on Bt- CCR. Also investigation of any health effect from milk and its products on human is urgently needed.**

Keywords **– Bt-cotton residues, Grazing, Animal health, Milk characteristics, GM-cotton.**

I. INTRODUCTION

Cotton is one of the main cash crops in the Sudan. The main three types of cultivated cotton are the long and the extra long staple (Gossypium barbadense), the medium and short staple cotton (G. hirsutum) are grown under irrigation and rain-fed. The crop contributed to different economical aspects, which included fiber export, oil production and grazing on its residues after harvest. Due to decline of grazing land, sheep and goats are let loose in the cotton fields for grazing by the farmers and shepherds after harvesting the cotton [1], however in Sudan cows communally grazed on cotton crop residues. Due to introduction of Bt – cotton (genetically modified cotton) since 2012, grazing on its residues and the animal products from feeding on it, began to be a matter of heated debate. However currently most genetically enhanced plants in market place provide insect protection or herbicide tolerance, are being used as feed for livestock [2].

Generally reports on genetically modified crops as animal feed included for example, Bt – corn silage [3, 4, 5] Soybean [6], cotton seeds [7] were cited. Many authors agreed on that, transgenic crops did not affect milk production and composition [3, 5, 7]. While some authors reported some effect on milk composition, for instance Steinke et al. (2010) reported higher contents of milk fat, lactose and proteins and [4] found an increase in the contents of milk protein, lactose and SNF. However recorded a dramatic reduction on average protein content in the colostrum and reduced fat, when goats were fed on GM soybean.

Since 2005, shepherds and farmers from different parts of India- particularly from the states of Andhra Pradesh, Haryana, Karnataka and Maharashtra have reported that their animals (cattle, buffaloes, sheep and goat) that have grazed on genetically modified cotton or have been fed genetically modified cotton seeds have fallen sick and in some instances have died [8]. However to date, not one public research institution has undertaken to systematically investigate the problem at the farmers field, and hence have no hard evidence to support their claims of "safety" (save the routine tests carried out prior to obtaining permission for commercial release of the crop). Each year however the animals belonging to shepherds and farmers continue to fall sick while they graze on Bt cotton, and there is not one National Research Institution willing to listen to them, and investigate and explore the field reality [8].

Sheep Mortality was observed in the flocks after 4 days of grazing on the Bt cotton crop. Lambs aged 3-4 months and young adults between 1-2 years were worst affected.

[9] Reviewed the animals fed Bt eggplant: various parameters in blood cells or chemistry were altered in goats and rabbits. in cows, milk production and composition were 10-14% changed rats had diarrhoea, higher water consumption, liver weight decrease as well as relative liver to body weight ratio decrease feed intake was changed in broiler chickens average feed conversion and efficiency ratios are changed in GE-fed fishes.

The debate over GM crops, and in particular GM food, has highlighted the potential positive and negative impacts of agriculture on human and animal health. Nutritional and safety assessments of GM foods have featured prominently with extensive study of GM crop nutrition and the fate of novel DNA and proteins in livestock products such as meat, milk and eggs reviewed by [10, 11, 12].

Due to fear among animal owners from grazing on Bt –cotton, Therefore, this research was designed with the following objectives. The opinion of respondent about effects of Grazing on Bt-cotton crop residues on animal health and milk characteristic of animal unit in Gezira State, Sudan.

II. Materials and Methods

2.1 The Study Area

Gezira State is located south-west of Khartoum state. The State lies between latitude 32°13′ and 30°15′N and longitudes 22°32′ and 20°43′E. It covers an area of about 27545km2 of which around 90% can be utilized for agriculture. It has a virtually flat relief, with slight tilt of the ground sloping gently from south to the north, which made possible the construction of a gravity-based irrigation system that covers all of the Gezira scheme. Gezira scheme which is a part of the state was mainly constructed for cotton production. Rainfall is characterized by high degree of spatial and temporal variability of wet and dry decades from season to season as well as within the same season. The state is divided into eight localities. South and Um-Algura localities were selected according to animal owner acceptance for conducting this research.

2.2 The Experiment

The questionnaire was conducted in two localities of Gezira State where cotton crop was cultivated. This included, South Gezira locality (Al- Madina Arab) and Um-Algura locality. The questionnaire was distributed randomly to 50 animal owners who already have experience with grazing of Bt-CCR, in each of the two localities.

2.3 Questionnaire

A questionnaire was designed to investigate the effect of grazing ruminants on Bt-cotton crop residues (Bt-CCR). It included the following questions:

Personal characteristics on grazing of ruminants on Bt-cotton crop residues (Bt-CCR). The personal characteristics included:
Education level.
Supervisor of Labor.
Dependence of the work site.
Marketing to milk channels.
Grazing of Bt-CCR on:
Type of cotton grown.
Feeding of ruminants on Bt CCR.
Concentrate feeding.
Effect on milk production.
If yes: what is the effect on:
Milk production.
Color of milk.
Taste of milk.
Milk coagulation time.
Impact on animal health.
Do you notice any symptoms from feeding on Bt-CCR.
Is there any case of diarrhea.
Type of the animal mostly affected bygrazing on Bt-CCR.

2.4 Statistical Analysis

Statistical analysis were performed using SPSS, Chi-square test was employed and the t-test was used for detection of difference between means.

III. Results and Discussion

Table (1). Percent opinion of respondent about Bt –CCR.

Parameter	Effect of feeding Bt-CCR	No effect of feeding Bt-CCR	Sig
Effect on milk production	93	7	
Increase in milk production	81	19	0.003
Effect on the color of milk	92	8	
Effect of the taste of milk	94	6	
There is an impact on animal health	80	20	
Symptoms of feeding on BT cotton	74	26	
Quick coagulation of milk	91	9	
Presence of diarrhea	85	15	
Increased frequency of affected animals by BT CCR grazing	96	4	

Table (1) revealed increase in milk production, the color of milk, the taste of milk, There is an impact on animal health, Symptoms of feeding on BT cotton, Quick coagulation of milk, presence of diarrhea and increased frequency of affected animals by BT CCR grazing. It was found that, Bt-CCR grazing had significantly different. It is clear that effect on the animals grazed on it almost all of the respondents agreed that Bt- CCR grazing had some effects on animals compared to non Bt-CCR. However some authors found some effects on milk composition, for example [5] reported a significant increase in milk fat, protein and urea in experiment included Bt – corn (Bt – MON 810) in the first lactation. In the second lactation, the authors found that, cows fed CON (Non – genetically modified diet) has a significantly lower milk, lactose. While, [4] found a significant increase in milk protein, lactose and SNF when cows fed the 2 GM corn.

Table (2). Percent effect of Bt-CCR on milk Production

Parameter	Effect of feeding Bt-CCR	No effect of feeding Bt-CCR
Significant impact	**54**	**7**
Little effect	**39**	
Total	**93**	
Sig	**0.000**	

It was indicated by Table (2) that, the percent total effect of Bt CCR on milk production was higher compared to no effect (93% versus 7%). Those complain from Bt CCR grazing is similar to that reported informally by shepherds and animal owners in India [8].

Table (3). Percent effect of Bt-CCR on increasing milk production

Parameter	Increasing milk production of feeding Bt-CCR	No increasing milk production of Feeding Bt-CCR	Sig
Very large increase	22		
A large increase	14		
Medium increase	13	19	0.000
A small increase	32		
Total	81	19	

Investigation of the total effect on increasing milk production table (3) was higher compared to no effect (81% versus 19%). From the investigation of effect on increasing milk production table (3), it is clear that almost 49% of the respondents claimed medium to very large increase in milk production from grazing on Bt-CCR. While only 32% claimed small increase. Generally CCR is one of low quality roughages and even if there is an increase in milk production may be relative to that produced from other roughages mainly sorghum straw.

Table (4). Percent effect of Bt-CCR on the color of milk

Parameter	Effect of feeding Bt-CCR	No effect of feeding Bt-CCR	Sig
Significant impact	46	8	0.000
Little effect	46		
Total	92	8	

Table. (4) revealed that, the effect of Bt-CCR grazing on milk color was significantly (P≤ 0.01) higher compared to no effect between the respondent opinion on the total effect of grazing Bt-CCR on the color of milk and the total no effect of grazing Bt-CCR on the color of milk. Generally more investigations that included consumers and milk processing units are needed. However unpublished data [13] found in a sensory evaluation, that Bt –CCR grazing had a significant (P<0.05) effect on color of milk. It is noticed that, there is an agreement between respondents on that grazing of Bt-CCR affects animal health. However, 50% of the respondent who claimed that there is an effect, claimed significant effect and the other 50% claimed small effect.

Table (5). Percent effect of Bt-CCR on milk taste

Parameter	Effect of feeding Bt-CCR	No effect of feeding Bt-CCR	Sig
Significant impact	53		
Little effect	41	6	
Total	94	6	0.000

As presented in Table (5) the total effect on milk taste was significantly (P≤ 0.01) higher] compared to the total no effect of grazing Bt-CCR on the test of milk (94% versus 6%). However unpublished data [13] found in a sensory evaluation, that Bt –CCR grazing had a significant (P<0.05) effect on milk taste. It is noticed that, there is an agreement between respondents on that grazing of Bt-CCR affects animal health (fig 1).

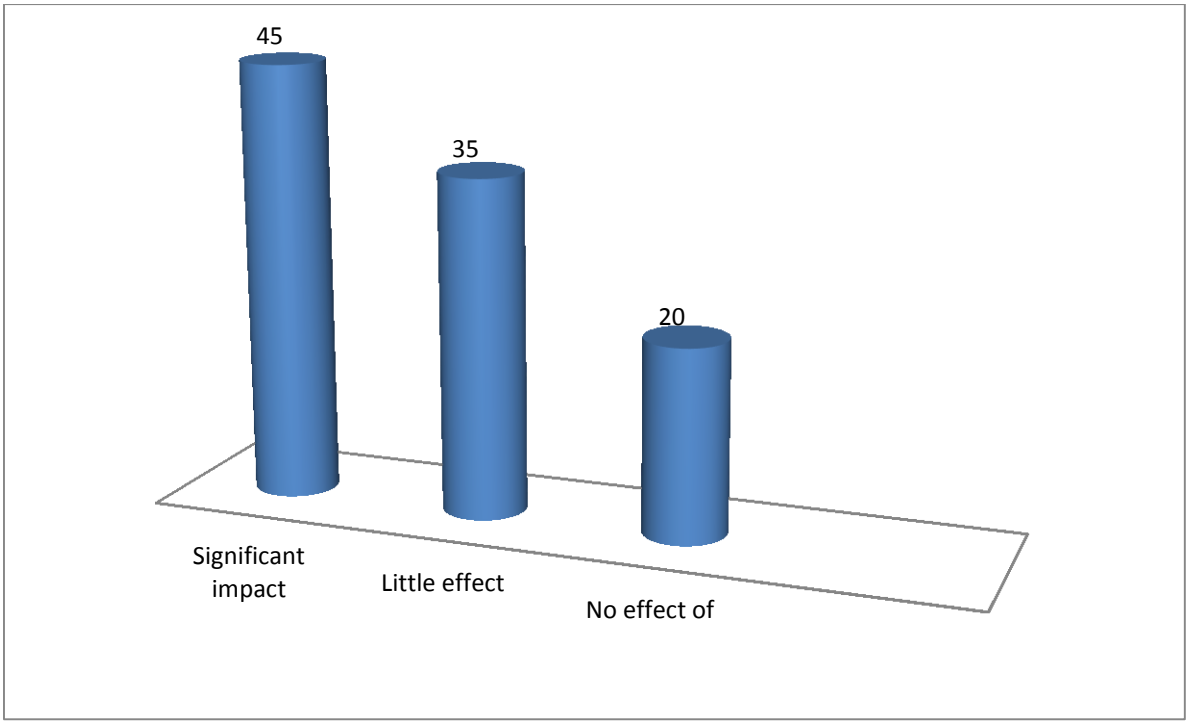

Fig. 1. Effect of Bt-CCR on animal health

Fig. 1. Showed the effect on animal health was higher in the total effect of grazing Bt-CCR on animal health compared to the total no effect of grazing Bt-CCR on animal health (80% versus 20%).

Table (6). Percent symptoms of feeding on Bt-CCR

Parameter	Effect of feeding Bt-CCR	No effect of feeding Bt-CCR	Sig
Diarrhea	**3**		
Diarrhea, common, achange in the color and taste of milk and mucus	**11**		
Diarrhea and Colds	**23**		
Diarrhea, A change in the color and taste of milk and mucus	**31**	**26**	**0.003**
Diarrhea and Bloat	**1**		
A change in the color and taste of milk and diarrhea	**5**		
Total	**74**	**26**	

As presented in Table (6) the total effect (symptoms) of feeding on Bt-CCR was significantly (P≤ 0.01) higher than no effect. [9] Reviewed the animals fed Bt eggplant: various parameters in blood cells or chemistry were altered in goats and rabbits in cows, milk production and composition were 10-14% changed. rats had diarrhoea, higher water consumption, liver weight decrease as well as relative liver to body weight ratio decrease feed intake was changed in broiler chickens average feed conversion and efficiency ratios are changed in GE-fed fishes.

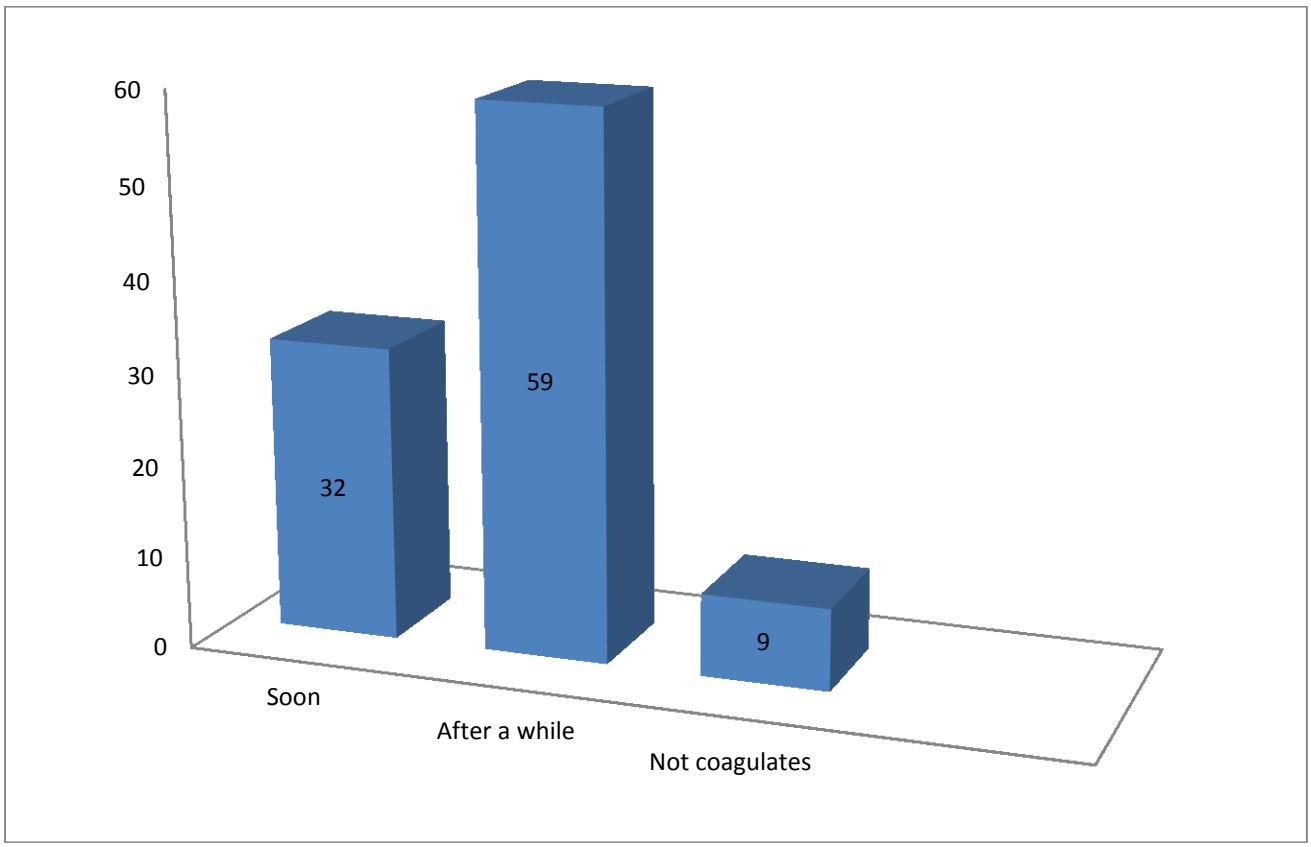

Fig. 2. Effect of Bt-CCR on milk coagulation

Effect on milk coagulation figure. (2) was higher in the total effect of grazing Bt-CCR on soon milk coagulation compared to the total no effect of grazing Bt-CCR on soon milk coagulation (91% versus 9%).

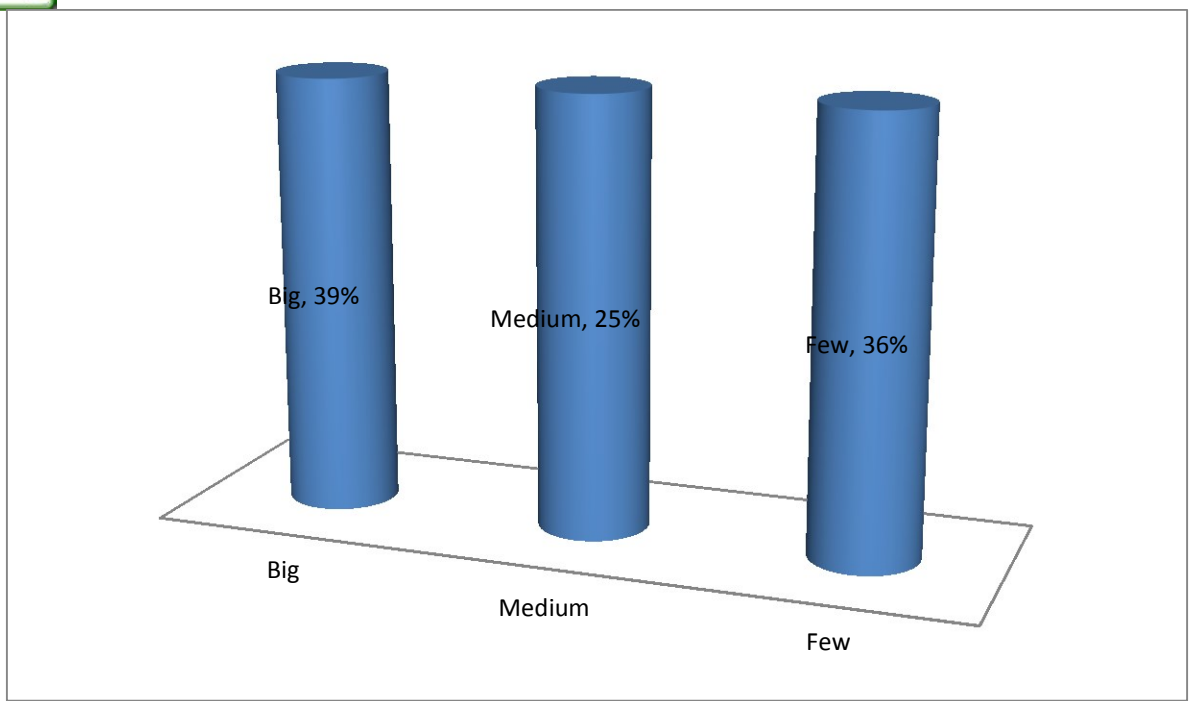

Fig. 3. Effect of Bt-CCR on milk production

It was indicated by figure (3) that, the total effect of Bt CCR on increasing milk production was higher compared to the total few effect of grazing Bt-CCR.

Table (7). Percent effect of Bt-CCR on diarrhea

Parameter	Effect of feeding Bt-CCR	No effect of feeding Bt-CCR	Sig
Large cases	**32**		
A few cases	**53**	**15**	
Total	**85**	**15**	**0.000**

Investigation of number of total animals affected by diarrhea Table (7) was significantly higher in animals grazed on Bt-CCR compared that not grazed. Again the same complains were reported by animal owners in India (informal reports). [14] Reviewed the effect of GMO feeds on animals; the author concluded that some effects of GMO feeds were noticed, for example, some farmers noticed many animal health problems resulting from GM food others noticed that, animal instinctively avoid the GMO food. However some authors reported no effect of GM food on animal production for instance, transgenic crops did not affect milk production and composition [3, 4, 5].

Table (8). Effect of Bt-CCR on different animal types

Parameter	Effect of feeding Bt-CCR	No effect of feeding Bt CCR	Sig
Cows	**19**		
Sheep	**3**		
Goat	**1**		
Cows and Sheep	**40**		
Cows and Goats	**18**		
Cows, sheep and goat	**13**		
Sheep and Goat	**2**	**4**	**0.000**
Total	**96**	**4**	

As presented in Table (8) the effect of CCR grazing on different animal types was higher in the total effect of grazing Bt-CCR on different animal types compared to the total no effect of grazing Bt-CCR on different animal types (96% versus 4%). Generally the result of this questionnaire indicated that, Bt–CCR affect the different type of animals grazed on it with different levels of effect. From this account it seems that, the study agreed on that, independent scientific studies on the safety of GM crops for animals or humans are severely lacking [15, 16, 17, 18] and there is a tendency for studies conducted by researchers with affiliations to the GM industry to give favorable results to GM crops [19]. [9] Reviewed the animals fed Bt eggplant: various parameters in blood cells or chemistry were altered in goats and rabbits in cows, milk production and

composition were 10-14% changed rats had diarrhoea, higher water consumption, liver weight decrease as well as relative liver to body weight ratio decrease feed intake was changed in broiler chickens average feed conversion and efficiency ratios are changed in GE-fed fishes.

CONCLUSIONS

This research addresses the opinion of respondents about effects of Grazing on Bt-cotton crop residues on animal health and milk characteristics, Gezira State, Sudan. Based on the study findings it could be concluded that:

1. There was an agreement between respondents in both sites on that, Bt-CCR had some effects on:
   - ❖ Milk production.
   - ❖ The color of milk.
   - ❖ The taste of milk.
   - ❖ The impact on animal health.
   - ❖ The milk coagulation.
2. There were some symptoms due to feeding on Bt CCR (if it is cultivated) which included:
   - ❖ Diarrhea alone.
   - ❖ Diarrhea with mucus.
   - ❖ Diarrhea and nasal discharge.
   - ❖ Diarrhea and bloat.
3. The most animals affected were cows and sheep.

RECOMMENDATIONS

It is recommended that, more investigations are needed to elucidate the reasons of those effects, before taking a decision to prohibit the grazing on Bt- CCR. Also investigation of any health effect from milk and its products on human is urgently needed.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

AUTHOR'S CONTRIBUTION

This work was carried out in collaboration between all authors. Author SEA designed the study, wrote the protocol and interpreted the data. Author BA anchored the field study, gathered the initial data and performed preliminary data analysis. Authors OA and LEI managed the literature searches and produced the initial draft. All authors read and approved the final manuscript.

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