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COMPARATIVE THERAPEUTIC EFFECT OF BENISEED EXTRACT, FERMENTED LIQUOR, FLAGYL AND TETRACYCLINE IN TREATMENT OF DIARRHOEA CAUSED BY SHIGELLA DYSENTRIAE IN ALBINO RATS.

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ABSTRACT

Diarrhoea, depending on the type is most characterized by the frequent passage of watery stool that may in some cases contains mucus and blood caused by either microorganisms, allergy or side effects of certain drugs. The efficacy of fermented beniseed liquor and the methanol extract in treating diarrhoea caused by *Shigella dysenteriae* in albino rats orogastrically infected with the bacteria was assessed. At the end of the experiment, microbiological, haematological, biochemical and liver functioning tests were performed on the blood from the animals. The results obtained from this analysis showed that the selected organism have high infectivity dose of 2.4×10^3 cfu/ml within 24-36 hours in rats of 82-102 g, caused a significant reducing effect on the weight of the albino rats and negative effect on the hematological and biochemical parameters assessed. Treatment of infected animals with the fermented liquor and methanol extract of beniseeds showed that both caused a significantly quick recovery of the infected animals from diarrhoea caused by the bacteria within five days of treatment. However, the rate of recovery was faster with the group of infected rats treated with the fermented beniseed liquor than the extract. Also, treatment with methanol extract of beniseeds also caused a significant increase in the cholesterol level of the blood from the animals. The results obtained from these analyses showed that beniseed have therapeutic properties and that the fermented form is more effective and can be used to treat diarrhoea caused by the selected bacteria used in this study in albino rats. The effect is however not as fast as the control drugs.

Key Words: Therapeutic; Beniseeds; Diarrhoea; Albino-rats; Flagyl; Tetracycline.

INTRODUCTION

Diarrhoea, a popular gastrointestinal infection common to both the young and old, is a condition that is characterized by frequent passage of watery stool that may in some cases contains mucus and blood is on the increase and has become worrisome (Brook *et al.*, 2014). Acute diarrhoea is the most frequent health problem of children especially after weaning. It is also a problem of travelers to developing countries and HIV-infected persons. Diarrhoea is difficult to treat because most of the antibiotics normally used may induce diarrhoea (Prescott *et al.*, 2017). Also, most of the causative organisms have become resistant to available antibiotics (Bada *et al.*, 2018). Beniseeds serves as food in various parts of the world and is an oil seed of worldwide significance. It is known to have medicinal properties. For example, the plant roots and leaves are used in treating migraine, hypertension, ulcers, constipation, chicken pox and

piles (Odugbemi, 2006). According to Ayo *et al.*, (2010), beniseed paste, when added to local kunun-zaki drink increased the protein, fat and energy content by over 20%. The seeds are tiny, flat ovals measuring about 3mm and are contained in the pods (Oshodi *et al.*, 2010). Non-culinary uses of the seeds include its use as an ingredient in soap, cosmetics, lubricants and medicines. The simplest and commonest use of sesame seeds now is sprinkling the seeds over cakes and breads, especially in Syria and Lebanon (Encyclopedia of spices, 2012). In Nigeria, the local names of Beniseeds are 'eluru' and 'ekuku' (Yoruba). The Ebiras call it 'gorigo'. In French it is called 'sesame', 'tahini' in Arabic while the Japanese call it 'goma'. ([http:// plants. Jstor. Org](http://plants.jstor.org), 2010). The plant belongs to the family Pedaliaceae and is mucilaginous in nature. It is an annual crop that grows to a height of about 1-2 m in tropical areas. It matures in 80-180 days depending on the fertility of the soil. Previous work on beniseeds showed that the fermented liquor and methanol extract of the seeds have antibacterial and immunostimulatory potentials. Flagyl is a trade name for a preparation of metronidazole (Crinsson 2019). It is an effective drug used as antibacterial and antiprotozoal. It comes in different doses according to EMDEX (2019). Tetracycline, on the other hand, is an antibiotic belonging to the tetracycline group. It is effective against Gram positive bacteria, Gram negative bacteria, rickettsia and some viruses (Richardson and Robinson, 2018). They equally come in different doses. The synergistic use of Flagyl and tetracycline for the treatment of diarrhoea is a very common drug of choice (EMDEX 2019).

There is however no record of the antibacterial, immunostimulatory potential and bio-safety of beniseeds, and though it serves as food, few qualitative data is available on its phytochemicals. This research is therefore focused on the comparative use of the fermented liquor and methanol extract of beniseeds and the drugs listed to treat albino rats infected with *Shigella dysenteriae* (a diarrhoeagenic bacterium).

Materials and methods

Collection of Beniseeds

The beniseed used was the golden yellow species which has been properly cleaned of debris and stones. It was purchased at Okene central market in Kogi State, Nigeria and Its identity was confirmed in the Department of Crop Science of the Federal University of Technology, Akure, Ondo State, Nigeria.

Collection of test organism

The test organism (*Shigella dysenteriae*) was isolated from a suspected patient's stool sample at the Microbiology Department, University College Hospital, Ibadan, Oyo State, Nigeria. The identity of the bacteria was confirmed using biochemical, morphological and molecular characteristics before storing on agar slant and kept in the refrigerator at 4°C (Cheesbrough 2014).

Fermentation of Beniseeds.

Five hundred grammes of the seeds was soaked in 1000ml of water for 3 days and grounded into a smooth paste using thoroughly washed electrical grinding machine according to the method of Momoh (2015). It was then filtered using muslin bag. The filtrate was allowed to undergo fermentation for 3days in a refrigerator. The fermented liquor was poured in air-tight container and stored in the refrigerator at 4°C to maintain its potency through the period of the treatment.

Preparation of Beniseeds extract

Ninety-eight percent methanol was used to extract the active components of beniseeds according to the method of Olorunnisola *et al.*, (2019) after pounding the dry form of beniseeds.

Determination of Infectivity dose (ID) of the test organism.

This was done using standard method described by Adebolu *et al.* (2017) for the test organism.

Infection of rats with test organism

The infection of the animals was done using the infectivity dose of the organisms by orogastrically dosing them according to the method of Adebolu *et al.* (2017).

Treatment of infected rats.

a) Extract and fermented liquor

A specific volume (0.75ml) of the extract and liquor was administered to the animals for 7days after infection has set in according to Momoh (2015).

b) Flagyl

A specific volume (0.75ml) of the drug at a concentration 5.0 mg/ml

c) Tetracycline

A specific volume (0.75ml) of the drug at a concentration 5.0 mg/ml

The following tests were carried out on the blood sample of the animals as:

- a. Biochemical tests such as determination of bicarbonate, creatinine, calcium, uric acid and urea level were done according to Baker *et al.*, (2014).
- b. Liver functioning test (LFT) such as the total bilirubin, serum total protein, serum albumin, serum globulin and alkaline phosphate were done to ascertain the liver functioning extent according to Zotta *et al.*, (2018).
- c. Haematological tests such as PCV, HB, RBC, ESR and WBC differential count were done according to Cheesbrough (2014).

The effect of the infection on the weight of the animals during the experiment was monitored using KERRO LAB DIGITAL SCALE (KERRO BLG 2000 Electronic scale series). Model BLC-20001.

Statistical analysis of results

Results obtained will be subjected to descriptive one way analyses of variance, SPSS version 23 Microsoft windows 8.1 and Duncan multiple range tests will be used as follow up test.

RESULTS

The result of the infection of the animals showed that the bacteria had a very high infectivity dose of 2.5×10^4 cfu/ml within 24-36 hours in rats of 82-105 g with physical signs such watery stool stained with blood and mucus. This result is shown in table 1.

Table 1: Results of infectivity dose of test organisms on albino rats

Microorganisms	Infectivity dose (cfu/mL)	Duration for infection to set in	Animal weight (g)
<i>S. dysenteriae</i>	2.5×10^4	24– 36 hours	88-102

Effects of treatment on health and weight of infected rats

Signs and symptoms of infection on animals infected with the various bacteria include watery or unformed stool, weakness characterized by slow movement, lack of appetite and falling of fur. There was also loss of weight in the animals within 24-36hrs after infection.

The infection with the bacteria caused a drastic reduction in the weight of the albino rats as the day increases and the infection becomes established in the animals. For instance, it caused the reduction of the weight of the rats to reduce from 88 g to about 80 g within a period of two (2) weeks of the research in the group infected and not treated as seen in table 2.

Table 2: Effect of infection and treatment with fermented beniseed liquor on the weight of albino rats infected *S. dysenteriae*.

Day	A	B	C	D	E	F
0	88.33±0.58 ^g	85.00±1.00 ^c	89.33±2.08 ^a	96.00±1.15 ^a	89.33±2.08 ^a	86.00±1.15 ^a
2	86.33±0.58 ^f	84.33±0.58 ^b	90.33±0.58 ^b	97.67±1.15 ^b	90.33±0.58 ^b	89.67±1.15 ^b
4	85.67±0.58 ^e	83.00±0.00 ^a	91.33±0.58 ^c	98.67±0.15 ^d	91.33±0.58 ^c	87.67±0.15 ^d
6	83.00±0.00 ^d	83.67±0.58 ^b	92.33±0.58 ^d	98.33±0.58 ^c	92.33±0.58 ^d	88.33±0.58 ^c
8	82.00±0.10 ^c	84.00±1.00 ^b	94.33±0.58 ^e	99.33±0.58 ^d	94.33±0.58 ^e	89.33±0.58 ^d
10	81.33±0.58 ^b	85.00±1.00 ^c	95.33±0.58 ^f	100.33±1.15 ^e	95.33±0.58 ^f	91.33±1.15 ^e
12	81.33±0.58 ^b	87.33±0.58 ^d	97.00±1.00 ^g	101.33±0.58 ^f	97.00±1.00 ^g	94.33±0.58 ^f
14	80.67±0.58 ^a	88.00±0.00 ^e	99.00±1.00 ^h	104.67±0.58 ^g	99.23±1.00 ^h	98.67±0.58 ^g

Values followed by the same letter in a column are not significantly different at $P \leq 0.05$.

Key: A=Infected and not Treated, B=Infected and Treated, C=Not infected but Treated, D=Not infected and not Treated, E= Infected and Treated with Flagyl, F= Infected and Treated tetracycline.

Comparatively, the treatment of the infection using methanol extract was equally effective. This is seen in the weight increase of the experimental rats after the treatment was able to overcome the infection by the 8th day of the experiment. However, the rate of recovery was not as fast as it is in the group treated with fermented beniseed, Flagyl or tetracycline. This result is represented in table 3.

Table 3: Effect of infection and treatment with methanol extract of beniseed on the weight of albino rats infected *S. dysenteriae*.

Day	A	B	C	D	E	F
0	65.00 ±0.67 ^f	65.67±0.58 ^d	65.00±1.00 ^a	64.33±1.58 ^a	89.33±2.08 ^a	86.00±1.15 ^a
2	63.33±0.58 ^e	63.33±0.58 ^c	66.33±1.00 ^b	65.33±1.53 ^b	90.33±0.58 ^b	89.67±1.15 ^b
4	62.67±0.58 ^e	61.33±0.58 ^b	67.67±1.15 ^c	66.67±0.58 ^c	91.33±0.58 ^c	87.67±0.15 ^d
6	60.33±0.58 ^d	60.67±0.58 ^b	69.67±0.58 ^d	66.67±0.58 ^c	92.33±0.58 ^d	88.33±0.58 ^c
8	57.33±0.58 ^c	60.33±0.58 ^a	70.00±1.00 ^d	67.67±1.52 ^d	94.33±0.58 ^e	89.33±0.58 ^d
10	55.67±0.58 ^b	61.00±1.00 ^b	71.67±1.15 ^e	68.00±1.00 ^e	95.33±0.58 ^f	91.33±1.15 ^e
12	53.00±1.00 ^a	62.67±0.58 ^c	72.33±0.58 ^e	69.67±0.58 ^f	97.00±1.00 ^g	94.33±0.58 ^f
14	52.65±1.00 ^a	63.00±1.00 ^c	72.33±0.58 ^e	69.00±1.00 ^g	99.23±1.00 ^h	98.67±0.58 ^g

Values followed by the same letter in a column are not significantly different at $P \leq 0.05$.

Key: A=Infected and not Treated, B=Infected and Treated with methanol extract, C=Not infected but Treated, D=Not infected and not Treated, E= Infected and Treated with Flagyl, F= Infected and Treated tetracycline.

Table 4 shows the result of the biochemical parameters examined at the end of the experiment. Worthy of note is the high level of urea and calcium in the group infected and not treated with anything. Comparatively, the bicarbonate was exceptionally high in the group that was treated without infection as well as the group that was treated with tetracycline drug.

Table 4: Results of biochemical analyses of infected albino rats with *S. dysentriae* and treated with fermented liquor of beniseeds.

Param eters	A	B	C	D	E	F
Bc	21.23±1.33 ^a	22.95±0.55 ^b	27.00±0.11 ^d	24.00±0.02 ^c	20.00±0.11 ^d	22.00±0.02 ^c
Cr	1.20±0.10 ^c	0.08±0.00 ^a	0.10±0.02 ^b	0.06±0.08 ^a	0.12±0.02 ^b	0.14±0.08 ^a
Ua	2.40±0.16 ^c	0.32±0.16 ^b	0.30±0.00 ^{ab}	0.25±0.06 ^a	0.33±0.00 ^{ab}	0.62±0.06 ^a
U	8.10±0.50 ^c	4.75±0.50 ^b	3.60±0.00 ^a	3.50±0.05 ^a	3.56±0.00 ^a	3.20±0.05 ^a
Ca	5.00±0.00 ^d	2.80±0.04 ^c	2.30±0.05 ^a	2.40±0.02 ^b	1.05±0.05 ^a	1.20±0.02 ^b

Values followed by the same letter in a row are not significantly different at $P \leq 0.05$.

Key: A=Infected and not Treated, B=Infected and Treated, C=Not infected but Treated, D=Not infected and not Treated, E= Infected and Treated with Flagyl, F= Infected and Treated tetracycline. Bc=Bicarbonate, Cr=Creatinine, Ua=Uric acid, U=Urea, Ca=Calcium.

The treatment with methanol extract of the beniseed also confer an increase in some biochemical parameters of the experimental rats as seen in the result presented in table 5. It should be noted that the infection caused an increase in the level of uric acid when compared to the group which were infected and treated in the experiment.

Table 5: Results of biochemical analyses of infected albino rats with *S. dysentriae* and treated with methanol extract of beniseeds.

Param eters	A	B	C	D	E	F
Bc	21.23±1.33 ^a	22.05±0.55 ^b	26.40±0.01 ^d	24.00±0.02 ^c	20.40±0.01 ^d	20.00±0.02 ^c
Cr	1.20±0.10 ^a	0.10±0.00 ^a	0.08±0.01 ^a	0.06±0.08 ^a	0.18±0.01 ^a	0.14±0.08 ^a
Ua	2.40±0.16 ^c	0.42±0.16 ^b	0.29±0.06 ^a	0.25±0.06 ^a	0.18±0.06 ^a	0.28±0.06 ^a
U	8.10±0.50 ^d	4.95±0.05 ^c	4.23±1.20 ^b	3.50±0.05 ^a	3.44±1.20 ^b	4.22±0.05 ^a
Ca	5.00±0.00 ^a	3.00±0.00 ^c	2.60±0.00 ^b	2.41±0.02 ^a	1.20±0.00 ^b	5.41±0.02 ^a

Values followed by the same letter in a row are not significantly different at $P \leq 0.05$.

Key: A=Infected and not Treated, B=Infected and Treated, C=Not infected but Treated, D=Not infected and not Treated, E= Infected and Treated with Flagyl, F= Infected and Treated tetracycline. Bc= Bicarbonate, Cr=Creatinine, Ua=Uric acid, U=Urea, Ca=Calcium.

The liver functioning results showed that the drugs also caused a significant increase in the parameters assayed for at the end of the experiment. However, while the infection and the Flagyl drug caused an increase in cholesterol level of the experimental rats, the level was relatively low in the group treated with tetracycline drug as seen in table 6.

Table 6: Liver functioning results of infected albino rats with *S. dysenteriae* and treated with fermented liquor of beniseeds.

Param eters	A	B	C	D	E	F
BT	9.25±1.15 ^a	9.60±1.15 ^b	13.50±0.21 ^d	10.50±0.20 ^c	11.20±0.21 ^d	10.04±0.20 ^c
STP	72.00±0.00 ^d	64.00±0.00 ^b	67.10±0.51 ^c	62.00±0.15 ^a	70.10±0.51 ^c	69.00±0.15 ^a
AST	29.10±0.10 ^d	24.10±0.25 ^b	22.54±0.15 ^a	24.08±0.68 ^c	27.82±0.15 ^a	28.22±0.68 ^c
ALT	36.25±0.75 ^d	26.55±0.35 ^b	26.00±0.60 ^a	28.70±0.12 ^c	33.12±0.60 ^a	29.98±0.12 ^c
Alk.Ph os	30.60±0.65 ^d	28.50±1.00 ^c	23.95±0.32 ^a	26.45±1.22 ^b	28.95±0.32 ^a	29.86±1.22 ^b
Cholest erol	2.30±0.95 ^d	1.62±0.44 ^c	1.30±0.00 ^a	1.50±0.02 ^b	2.10±0.00 ^a	1.80±0.02 ^b

Values followed by the same letter in a row are not significantly different at $P \leq 0.05$.

Key: A=Infected and not Treated, B=Infected and Treated, C=Not infected but Treated, D=Not infected and not Treated, E= Infected and Treated with Flagyl, F= Infected and Treated tetracycline. BT=Bilirubin total, STP=Serum total protein, AST=Aspartate transferase test, ALT=Antilymphocyte transferase test, ALK=Alkaline phosphatase.

The liver functioning results shown in table 7 had a different pattern. It showed that the drugs caused a significant decrease in the parameters assayed for at the end of the experiment when compared with the result in table 6. However, while the infection and the Flagyl drug caused an increase in cholesterol level of the experimental rats, the level was relatively low in the group treated with tetracycline.

Table 7: Liver functioning results of infected albino rats with *S. dysenteriae* and treated with methanol extract of beniseeds.

Parameters	A	B	C	D	E	F
BT	9.25±1.25 ^a	9.40±0.00 ^b	13.50±0.12 ^d	10.50±0.20 ^c	10.20±0.12 ^d	8.50±0.20 ^c
STP	72.00±0.00 ^d	67.25±0.05 ^b	69.23±0.11 ^c	62.00±0.15 ^a	68.90±0.11 ^c	66.00±0.15 ^a
AST	29.10±0.10 ^d	26.00±0.00 ^c	20.50±0.45 ^a	24.08±0.68 ^b	28.60±0.45 ^a	27.68±0.68 ^b
ALT	36.25±0.75 ^d	26.90±0.30 ^a	29.80±0.00 ^c	28.70±0.12 ^b	33.80±0.00 ^c	32.96±0.12 ^b
Alk.Phos	30.60±0.65 ^d	29.10±1.00 ^c	25.90±0.67 ^a	26.45±1.22 ^b	29.80±0.67 ^a	28.45±1.22 ^b
Cholesterol	2.30±0.95 ^b	2.10±0.01 ^b	3.28±0.65 ^c	1.50±0.02 ^a	1.85±0.65 ^c	1.90±0.02 ^a

Values followed by the same letter in a row are not significantly different at $P \leq 0.05$.

Key: A=Infected and not Treated, B=Infected and Treated, C=Not infected but Treated, D=Not infected and not Treated, E= Infected and Treated with Flagyl, F= Infected and Treated tetracycline. BT=Bilirubin total, STP=Serum total protein, AST=Asparate transferase test, ALT=Antilymphocyte transferase test, ALK=Alkaline phosphatase.

Figure 1 showed a plot of the haematological parameters of the rats used in the experiment. Generally, all the groups recorded a high and an approximately the same level of lymphocyte count in all the groups, an indication that both the infection as well as the treatments does not have much effect on the lymphocytes. However, the infection caused a significant increase in the level of the neutrophil and a decrease in the level of PCV.

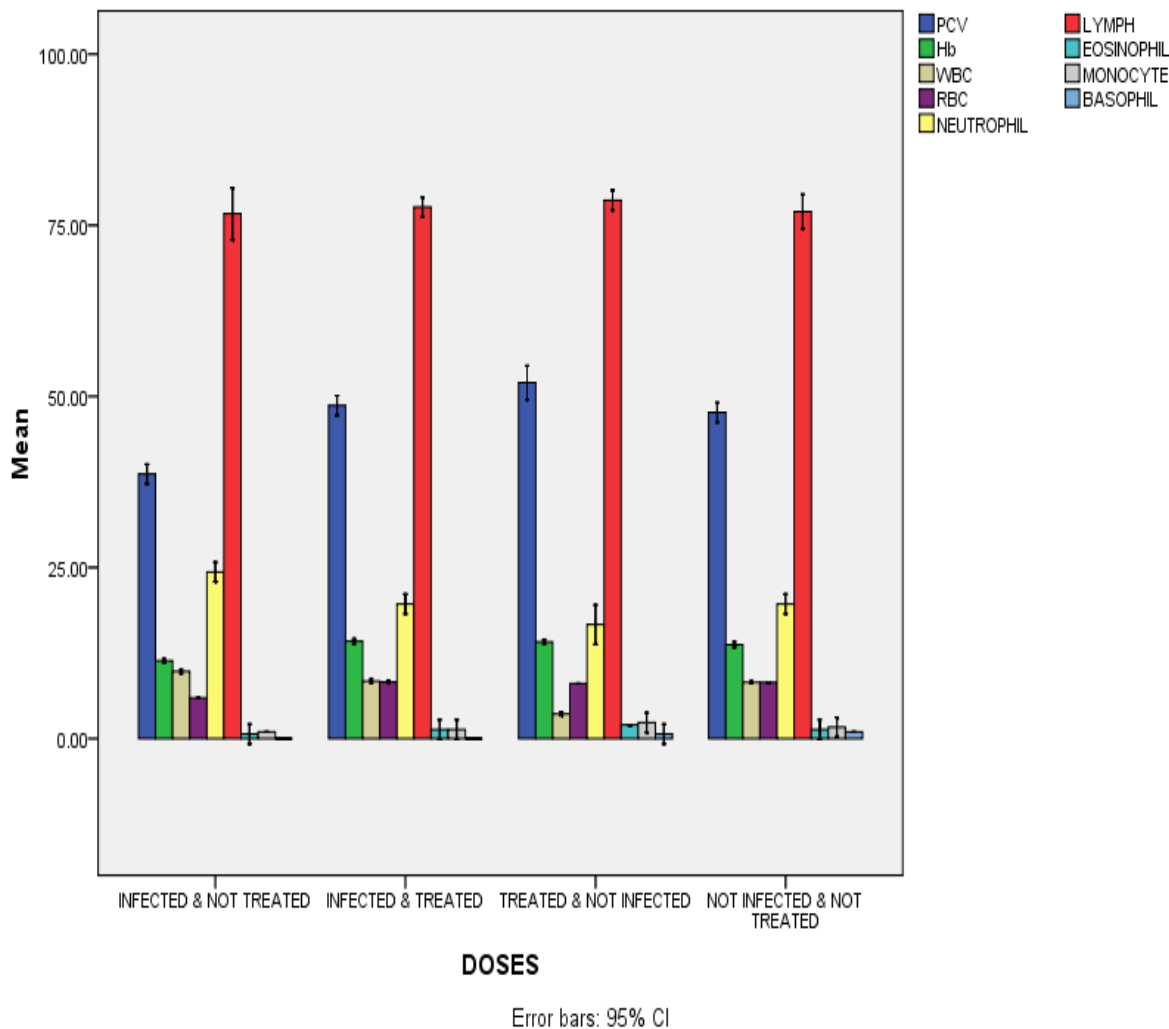


Fig 1: Haematology

result of rats infected with *S. dysenteriae* and treated with fermented beniseed liquor.

Table 8 showed the same pattern of result as the figure above, but it more detailed in that it showed the haematological parameters of the rats used in the experiment. Generally, all the groups recorded a high and an approximately the same level of lymphocyte count in all the groups, an indication that both the infection as well as the treatments does not have much effect on the lymphocytes. However, the infection caused a significant increase in the level of the neutrophil and a decrease in the level of PCV.

Table 8: Haematological results of rats infected with *S. dysenteriae* and treated with methanol extract of beniseeds

TR	ESR	PCV	HB	WBC	RBC	LYMP	NEUT	MONO	EOSIN	BAS
T										
A	1.00±0.0 0 ^a	41.00±1.7 3 ^b	13.43±0.4 9 ^b	8.57±0.15 a	8.30±17 ^b	71.00±0.0 0 ^b	22.33±0.5 8 ^b	5.00±0.0 0 ^b	1.33±0.5 8 ^a	0.67±0.5 8 ^b
B	2.00±0.0 0 ^b	33.33±1.5 3 ^a	10.17±0.5 1 ^a	14.80±0.2 6 ^d	6.07±0.12 a	66.67±0.5 8 ^a	25.00±0.0 0 ^c	2.67±0.5 8 ^a	0.67±0.5 8 ^a	0.00±0.0 0 ^a
C	1.00±0.0 0 ^a	43.33±0.5 8 ^c	14.20±0.2 6 ^b	9.37±0.57 b	9.45±0.0.3 9 ^c	72.33±0.5 8 ^c	21.00±1.0 0 ^a	5.33±0.5 8 ^b	1.33±0.5 8 ^a	0.00±0.0 0 ^a
D	1.00±0.0 0 ^a	39.67±0.5 8 ^b	13.47±0.4 2 ^b	10.07±0.1 2 ^c	9.43±0.21 c	72.00±0.0 0 ^b	21.67±0.5 8 ^a	4.67±0.5 8 ^b	1.67±0.5 8 ^b	1.00±0.0 0 ^b
E	1.00±0.0 0 ^a	44.13±0.5 0 ^c	15.20±0.2 8 ^b	10.37±0.5 7 ^b	9.22±0.0.3 9 ^c	70.33±0.5 8 ^c	21.00±1.0 0 ^a	5.33±0.5 8 ^b	1.33±0.5 8 ^a	0.00±0.0 0 ^a
F	1.00±0.0 0 ^a	42.57±0.5 3 ^b	12.47±0.4 2 ^b	11.07±0.1 2 ^c	9.83±0.21 c	71.00±0.0 0 ^b	21.67±0.5 8 ^a	4.67±0.5 8 ^b	1.67±0.5 8 ^b	1.00±0.0 0 ^b

Values followed by the same letter in a column are not significantly different at $sP \leq 0.05$.

Key: A=Infected and treated, B=Infected not treated, C=Treated not infected, D=Not infected not treated, E= Infected and Treated with Flagyl, F= Infected and Treated tetracycline.

DISCUSSION

Beniseed has been used for ages due to its therapeutic properties, however, this research is a scientific proof of this therapeutic properties embedded in it. The infection set in within 24-36 hours which shows that the bacteria has high pathogenicity. According to Cheesbrough (2014), *S. dysenteriae* is one of the highly pathogenic bacteria with high infectivity. The signs and symptoms of the infection in the experimental rats are the same for people who drank water contaminated with *S. dysenteriae* as indicated by Nwidu *et al.*, (2018).

The effect of the bacteria on the weight of the infected albino rats indicates that if no measure meted on the animals after infection set in, it might lead to death. According to Omoya *et al.*, (2018), most of diarrhoeagenic bacteria are highly pathogenic with the exception of *E.coli* which may cause self-limiting diseases or diarrhoea. The bacteria used in this research has shown that *S. dysenteriae* is one of the highly pathogenic diarrhoeagenic bacteria.

Biochemically, the bacteria caused significant increase in bicarbonate level. This may be due to loss of vital electrolytes from the body of the animals due to the diarrhoeagenic faeces the animals are excreting. EMDEX, (2019) the bacteria is capable of reducing vital ions from the body fluid that may consequently affect the biochemical parameters of the

blood. However, the reduction in other parameters such as creatinine, urea, uric acid and calcium by the bacteria was expected. According to Kawecki *et al.*, (2018), most diarrhoeagenic bacteria that induce watery stool and loss of electrolytes will ultimately cause reduction in these biochemical parameters.

The effect of the drugs (Flagyl and tetracycline) far exceed the effect of the extract and fermented liquor of the beniseed used in this research. The reason according to Prescott *et al.*, (2017) is that these drugs would have undergone a lot of purification processes as well as detail pharmacological tests that made them acceptable world-wide as agents that can curb diarrhoea in man and animals. Therefore, it is probably possible and reasonable to say that if the extract and the fermented liquor of beniseed are subjected to further purification and packaging, it may have better therapeutic effect than these drugs.

Comparatively, the therapeutic effect of the fermented beniseed liquor was more than that of the methanol extract because the rats infected and treated with liquor all recovered within a period of 5days while those treated with extract recovered after 5days. This is however not the same with the ones treated with drugs. Flagyl was the most effective followed by tetracycline. The rats treated with Flagyl recovered within 48 hours while that of tetracycline recovered after 72 hours. According to EMDEX (2019), the purity of the drugs and the effectiveness of the bioactive components may be responsible for these results. It may also be due to the fact that the fermented beniseed liquor may be absorbed faster by the stomach walls of the intestine of the rats. According to Cutting, (2011), fermented foods, especially in liquid form are absorbed faster than the unfermented ones by the walls of the small intestine and that they get to the small intestine faster because no digestive enzyme act on them.

The fermented beniseed liquor and methanol extract are therefore effective therapy for diarrhoea caused by *Shigella dysenteriae*, but not as effective as the drugs tested. Therefore, in an emergency situation where an immediate result is required, these drugs will be preferred. Equally, the beniseed liquor should be used to treat the diarrhoea caused by *S. dysenteriae* where antibiotics have been found resistant by the organism as well as in rural areas where antibiotics are not easily accessible.

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