IAMJ

Research Article International Ayurvedic Medical Journal ISSN:2320 5091

ROLE OF MUSTA (*CYPERUS ROTENDUS* LINN.) IN MANAGEMENT OF PEDIATRIC DIARRHEA

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ABSTRACT

Diarrhea is responsible for approximately 2 million deaths annually in whole world under the age of 5 years. Early and repeated episodes of childhood diarrhea during period of critical development may cause long term complications like, malnutrition, repeated infectious diseases, anemia and many times death. Ancient Acharyas quoted various therapies and drugs for *Balatisara* (diarrhea in pediatric patients). Out of these drugs Charaka mentioned *Musta* as best *Dipaniya* (appetizer), *Pachaniya* (digestive), *Samgrahika* drug. Decoction of *Musta* along with honey was used as a formulation & given in dose mentioned in the ancient texts. Children suffering from *Atisara* less than 7 days duration, age between 6 months to 24 months free from any other systemic illness mild or moderate dehydration were included in this study. It was then divided in two groups A (Given *Musta* Decoction + ORT) & B (Given ORT only). *Mustakwatha* with ORT shows better results for childhood diarrhea as compared to only ORT. *Musta kwatha* with *Madhu* can be used as effective remedy for childhood Diarrhea.

Keywords: *Balatisara, Musta, Dipaniya, Pachaniya, Samgrahika*

INTRODUCTION

Pediatric age group is dependent and immature. In this age group *body systems* are immature, more delicate, tender skin susceptible for any infection and immunity is poor, due to this condition children are always prone to suffer from various diseases. Amongst the entire pediatric diarrhea, is a common and potentially fatal disease? Persistently high rates of Diarrhea among young children despite intensive efforts at control are of particular concern.[1] Diarrheal illness may have a significant impact on psychomotor and cognitive development in young children. Early and repeated episodes of childhood diarrhea during period of critical development may cause long term complications like, malnutrition, repeated infectious diseases, anemia and many times death. Diarrhea is responsible for approximately 2 million deaths annually in whole world under the age of 5 years. [2] Each year in developing countries, roughly 4 billion episodes of acute diarrhea or approximately 3.2 episodes per child, occurs among children under 5 years of age. In India < 5 years of age children from urban slum areas may get up to 6-8 episodes per year.[3] In this 5 years age group, diarrhea is most common up to 2 years of age due to top feeding, dentition, recent change in feeding habit may prone them to infection causing diarrhea. In Ayurveda *Vagbhatacharya* told that the process of dentition is more responsible for the illness of children.[4] Ancient *acharyas* quoted various therapies and drugs for *Balatisara* (diarrhea in pediatric patients). Out of these drugs, pro-

posed study included *Musta kwatha* (decoction) with *Anupan* (vehicle) honey which is mentioned in text *Nighantu Aadarsh*.[5] As mentioned in *Charaka, Musta* is best appetizer, *digestive*, *anti-diarrheal* drug.[6] Current scientific world is eagerly watching Ayurveda; an ancient system of medicine, a compilation of observations, experiences, research of good number of scholars so present study compare the effectiveness of ancient remedy *Musta decoction* with oral rehydration therapy against only oral rehydration therapy which is core of treatment for diarrhea in present era.

MATERIALS AND METHODS: For the clinical study of efficacy of *Musta in pediatric diarrhea, patients* were selected from the OPD of Kaumarbhritya department of Government Ayurved College, Nanded, Maharashtra, India

MATERIALS USED IN STUDY

- *Decoction of Musta*
- Oral Rehydration Therapy (ORT)
- *Madhu* (honey)
- 5 cc syringe.

Patients Selection Criteria

- Child suffering from *diarrhea* less than 7 day's duration.
- Age between 6 months to 24 months.
- Free from any other systemic illness.
- Child with No, mild or moderate dehydration.

Exclusion Criteria

- Child suffering from *Visuchika* (cholera) and *Pravahika* (dysentery).
- Having severe dehydration.
- Any serious medical or surgical emergency.
- Manifestation of any complication during treatment.

INVESTIGATION: Stool examination (routine and microscopic).

PARAMETERS

- Frequency of motions.
- Consistency of stool.
- Degree of dehydration.

Frequency of Motions

Frequency of motion means number of motions within 24 hours. According to frequency of motion normal bowel pattern varies in infants and children, so score for frequency of motion is considered as below.

Table No. 1 Gradations of Diarrhea

Sr. No.	Parameters	Signs	Grade
1	Frequency of stool	Before diarrhea	**0**
		Decrease	1
		No change	2
		Increase	3
2	Consistency of stool	Normal	0
		Semisolid	1
		Watery	2
3	Degree of Dehydration	No	0
		Some	1
		Severe	2

Table No. 2 Types of Dehydration

Symptom	Min. or No dehydration <3% loss of Body Weight	Mild to Mod. Dehydration 3-9% loss of body weight.	Severe dehydration >9% loss of body weight.
Mental Status	Well, Alert.	Normal, fatigued or restless irritable	Apathic lethargic, unconscious.
Thirst	Drinks normally might refuse liquid.	Thirst, eager to drink.	Drink poorly or unable to drink.
Heart rate	Normal	Normal or increased	Tachycardia with bradycardia in most severe

			cases.
Quality of Pulses	Normal	Normal or decreased	Weak, thready or im-palpable.
Breathing	Normal	Normal, fast	Deep
Eyes	Normal	Slightly sunken	Deeply Sunken
Tears	Present	Decreased	Absent
Mouth and Tongue	Moist	Dry	Parched
Skin fold	Instant recoil	Recoil < 2 sec in.	Recoil > 2 sec
Capillary re-fill	Normal	Prolonged	Prolonged Minimal
Extremities	Warm	Cool	Cold mottled cyanotic
Urine output	Normal to decreased	Decreased	Minimal

Musta Kwatha

Patients of experimental group received freshly prepared *Musta* decoction with honey.

Preparation of *Kwatha* (Decoction)

40 gms of *powder* was taken & 16 times water was added to it, heated it up till remains 8th part of water. It was then used for patients in lukewarm state.[7]

5 cc syringes were used to give appropriate dose of *kwatha. Kwatha* was prepared by scholar and given to patient up to its IPD admission while doing this mother / parent instructed to observe the whole procedure of *kwatha Nirmana* and dose maintenance. If patient was discharged before 7 days of treatment, then parents were instructed to prepare *kwatha* up to completion of treatment.

Dose: The dose of medicine like *Kalka* and *Churna* for neonatal period up to age of one month is one *Ratti* (125mg) and preferably is given by mixing with *ksheer (milk), Kshaudra (honey), Seeta (sugar)* or ghee. After the age on one month the mentioned dose can be increased one *Ratti* for each month up to the end of one year that means the dose of medicine for one year and old child is one *Masha* (1 to 1.5gm). This dose of medicine is increased one *Masha* for each year so the dose becomes sixteen *Masha* at the age of sixteen years and maintain constant up to the age of seventy years.[8] The above quotation also mentions that the dose *kashaya* is four times of above given dose. For this study, the dose of *Kwatha* for various age group is calculated as below.

- 6 months - 3ml
- 6 months – 12 months -6ml
- 12 months – 18 months -9ml
- 18 months – 24 months -12ml

Syringe: Five cc disposable syringes were used for correct dosage of *Musta kwatha*.

Standardization of *musta kwatha:* Standardization of prepared musta kwatha done from authorized laboratory and the values observed are as below tables.

Table No. 3 Result of Analysis of *Musta Kwatha*

Parameter	Result
p^{H}	6.60
Specific Gravity	1.0850
Refractive Index	1.2300
Total soluble solid	23.18%

Table No. 4 Result of Analysis of Honey

Parameter	Result
Moisture	21.50%
Specific Gravity	1.3924
Reducing Sugar	72.36%
Fructose Glucose Ratio	1.06
Sucrose	Traces
Total acidity	0.11%
Total ash	0.019%
Fiche test	Negative
Aniline chloride test	Negative

Patient attending to study place were selected according to inclusion and exclusion criteria. Parents were explained the objective and methodology and interested parents were involved in the study.

Written Consent: First of all, written consent was obtained from legal guardians i.e. mother and father.

History and Examination: Parents were asked for detailed history of antenatal, prenatal and postnatal period, previous illness and present complaints. Socioeconomic status and baby was examined from head to toe.

Division of Patients in Experimental and Control Group: Thirty patients of *pediatric diarrhea* were randomly allotted as follows

Group A - experimental group - receive *Musta Kwatha* + *Madhu* along with ORT

Group B - control group - receive ORT respectively.

Record of Observation: Observational parameters were recorded on 1st, 3rd, 5th, 7th day of treatment. They were recorded under the same heading respectively.

Statistical Analysis: Appropriate statistical measured of significance like Chi Square test, paired 't' test and unpaired 't' test were used for analysis.

ORT (Oral Rehydration Therapy)

To avoid sequel of dehydration and biasness in study, ORT was given to both groups which forms the core of treatment for dehydration due to diarrhea in present era. ORT was offered to patients in both group after assessment of severity of dehydration according to WHO criteria and ORT was given according to plan A and plan B.

Treatment Plan A: Patients without physical signs of dehydration: Along with administration of ORS advised to take increased amount of culturally appropriate home available fluids as mentioned in ORT. ORS administered up to 500 ml per day or 5-100 ml of ORS after each loose stool.

Treatment Plan B: Patient with physical signs of dehydration:

All cases examined carefully and the fluid therapy divided into three components.

Rehydration Therapy: Correction of existing water and electrolyte deficit was indicated by the presence of signs of dehydration by 75 ml/kg of ORT within the first 4 hours of IPD admission.

Maintenance Fluid Therapy: This was started when signs of dehydration disappear. Usually within first 4 hours ORS was administered in volume equal to diarrheal losses, i.e. approximately 10-20 ml/kg body weight for each liquid stool. ORS is administered in this manner till diarrhea stops. Offer plain water in between. Breast feeding is given even during rehy-

dration and offered semisolid foods soon after deficit replacement. Similarly in non-breastfed babies, milk preferably mixed with cereals is used with other semisolid foods after they have been rehydrated. If the child continued to have some dehydration after four hours, another 4 hours treatment as in rehydration therapy was repeated along with offering of feeds, milk and breast feeding.

Treatment Schedule: All patients in study were admitted in IPD for at least one day to explain mother about ORT and its importance and use. *Kwatha* was prepared and given by scholar during the IPD stay of patient.

Instruction to Parents: Wash the hands with soap and water before preparing solution or *kwatha*.

- Prepare solution in clear pot.
- Wash your and the baby's hands with soap and water before administering the solution.
- Give the child as much as of the solution as it needs, in small amount frequently.
- Give child alternately other fluids such as breast milk, carrot soup, rice water–congee, orange juice or mashed banana.
- ORT does not stop diarrhea. It improves the body from drying up. The diarrhea will stop by itself.
- If the child vomits, wait for ten minutes and give ORT again. Usually vomiting will stop.
- If diarrhea increases and / or vomiting persists, take child over to doctor

RESULT

Consistency of Stool: Experimental Group- Table no. 5 Consistency of stool

	1st-3rd day	**3rd-5th day**	**5th-7th day**	**1st-7th day**
Mean	0.566	0.734	0.566	**1.867**
SD	0.576	0.407	0.508	**0.346**
SE	0.105	0.074	0.093	**0.063**
't' Value	5.390	9.919	6.086	**29.635**
't' table	2.05	2.05	2.05	**2.05**
P Value	**P<0.05**	**P<0.05**	**P<0.05**	**P<0.05**

Patients in Experimental Group are compared before and after treatment on 7th day of by applying paired 't' test, shows 't' value 29.635 which is highly significant at P = 0.05 significant level.

Control Group- Table no. 6 Consistency of stool

	1st-3rd day	**3rd-5th day**	**5th-7th day**	**1st-7th day**
Mean	0.267	0.533	0.601	**1.401**
SD	0.583	0.507	0.498	**0.563**
SE	0.106	0.093	0.091	**0.103**
't' Value	2.51	5.731	6.604	**13.601**
't' table	2.05	2.05	2.05	**2.05**
p Value	**p<0.05**	**p<0.05**	**p<0.05**	**p<0.05**

Patients in control group are compared before and after treatment on 7th day by applying paired 't' test shows 't' value 13.601 which is significant at P = 0.05 significant level.

Comparison by Unpaired't' test

Table no.7 Consistency of Stool

	1st-3rd day	3rd-5th day	5th-7th day	1st-7th day
Mean Diff	0.299	0.201	-0.035	**0.466**
Comb SD	0.580	0.460	0.502	**0.466**
SE	0.146	0.119	0.130	**0.121**
't' Value	2.051	1.689	-0.269	**3.851**
't' table	2.05	2.05	2.05	**2.05**
P Value	**P<0.05**	**P>0.05**	**P>0.05**	**P<0.05**

When both groups were compared on 7th day of treatment for consistency of stool by applying unpaired't' test, it was found that experimental group shows significantly better results than control group through both group are statistically significant.

Frequency of Motions: Experimental Group- Table no.8 Frequency of Motion

	1st-3rd day	3rd-5th day	5th-7th day	1st-7th day
Mean	0.633	0.767	0.433	**1.833**
SD	0.556	0.305	0.490	**0.305**
SE	0.101	0.056	0.089	**0.056**
't' Value	6.267	13.696	4.865	**32.732**
't' table	2.05	2.05	2.05	**2.05**
P Value	**P<0.05**	**P<0.05**	**P<0.05**	**P<0.05**

Patients in Experimental Group are compared before and after treatment on 7th day by applying paired 't' test, shows t value 33.732 which is highly significant at P = 0.05 significant level.

Control Group- Table no.9 Frequency of Motion

	1st-3rd day	3rd-5th day	5th-7th day	1st-7th day
Mean	0.300	0.733	0.367	**1.400**
SD	0.466	0.521	0.490	**0.498**
SE	0.085	0.095	0.089	**0.091**
't' Value	3.529	7.716	4.124	**15.380**
't' table	2.05	2.05	2.05	**2.05**
P Value	**P<0.05**	**P<0.05**	**P<0.05**	**P<0.05**

Patients in control group are compared before and after treatment on 7th day by applying paired 't' test shows 't' value 15.380 which is significant at P = 0.05 significant level.

Comparison by Unpaired't' test

Table no. 10 Frequency of Motion

	1st-3rd day	3rd-5th day	5th-7th day	1st-7th day
Mean	0.333	0.034	0.066	**0.433**
SD	0.513	0.427	0.490	**0.414**
SE	0.133	0.110	0.126	**0.107**
't' Value	2.504	0.309	0.524	**4.047**
't' table	2.05	2.05	2.05	**2.05**
P Value	**P<0.05**	**P>0.05**	**P>0.05**	**P<0.05**

When both groups were compared on 7th day of treatment for frequency of motion by applying unpaired 't' test, it was found that Experimental group shows significant-

ly better result than Control Group though both group are statistically significant (at P=0.05).

Degree of Dehydration: Experimental Group- Table no. 11 Degree of Dehydration

	1st-3rd day	3rd-5th day	5th-7th day	1st-7th day
Mean	0.533	0.233	0.167	**0.933**
SD	0.507	0.430	0.379	**0.252**
SE	0.093	0.079	0.069	**0.046**
't' Value	5.731	2.949	2.420	**20.282**
't' table	2.05	2.05	2.05	**2.05**
P Value	**P<0.05**	**P<0.05**	**P<0.05**	**P<0.05**

Patients in experimental group are compared before and after treatment on 7th day by applying paired 't' test, shows 't' value 20.282 which is significant at P = 0.05 significant level.

Control Group- Table no. 12 Degree of Dehydration

	1st-3rd day	3rd-5th day	5th-7th day	1st-7th day
Mean	0.366	0.300	0.267	**0.933**
SD	0.490	0.466	0.449	**0.256**
SE	0.089	0.085	0.082	**0.046**
't' Value	4.112	3.529	3.256	**20.282**
't' table	2.05	2.05	2.05	**2.05**
P Value	**P<0.05**	**P<0.05**	**P<0.05**	**P<0.05**

Patients in control group are compared before and after treatment on 7th day by applying paired 't' test shows 't' test value 20.286 which is significant at P = 0.05 significant level.

Comparison by Unpaired't' test

Table no. 13 Degree of Dehydration

	1st-3rd day	3rd-5th day	5th-7th day	1st-7th day
Mean Diff.	0.167	-0.067	-0.100	**0.000**
Comb. SD.	0.499	0.448	0.416	**0.255**
SE	0.129	0.116	0.108	**0.066**
't' Value	1.29	-0.578	-0.926	**0.000**
't' table	2.05	2.05	2.05	**2.05**
P Value	**P>0.05**	**P>0.05**	**P>0.05**	**P>0.05**

When both Groups were compared on 7th day of treatment by applying unpaired 't' test for degree of dehydration it was found that there was no difference with 't' test value of 'O' which is insignificant at P = 0.05 significant level. Hence both groups show statistically equal effect on dehydration. From given three parameters of study, while discussing efficacy of given treatment total score of all the three parameters before treatment and that of after treatment was counted. The treatment is considered highly effective when the total score before treatment gets totally decreased after treatment. The treatment is considered moderately effective when the total score before treatment gets decreased but not zero after given full course of treatment. The treatment is considered not effective if total score before treatment remain unchanged after treatment. From

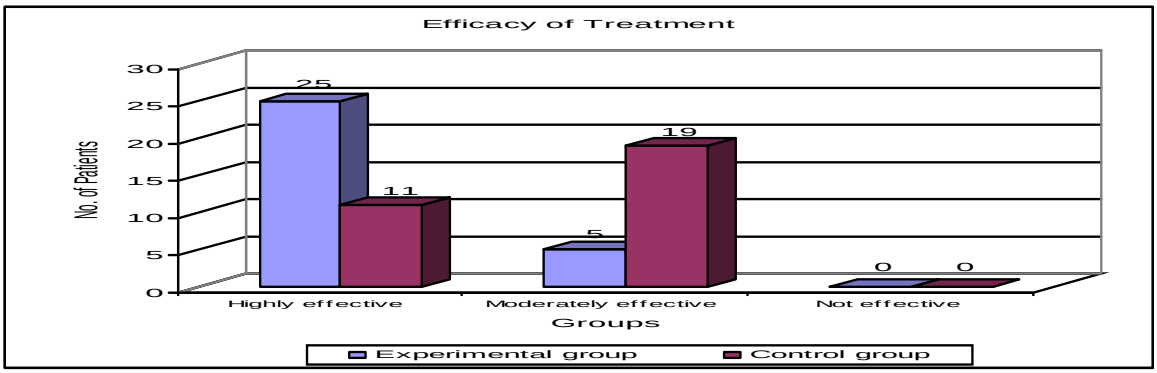
statistical observation the efficacy of drug in both groups can be stated as follows.

Table no.14 Effect of *Musta Kwatha*

Efficacy of treatment	Experimental group	Control group
Highly effective	25 (83.33%)	**11 (36.67%)**
Moderately effective	5 (16.67%)	**19 (63.33%)**
Not effective	**0.00**	**0.00**

¡ ^{2} = 13.610 **P<0.05 Significant**

Fig.1 Efficacy of Treatment



From above statistical data experimental group treatment shows highly effective results in 83.33% patient and moderately effective result in 16.67% patients control group treatment shows highly effectiveness in 36.7 patients and moderately effectiveness in 63.33% patients. According to chi-squre test given chi-squre value 13.610 is highly significant at P = 0.05 significant level.

DISCUSSION

Pediatric diarrhea is the commonest disease found during childhood and is a leading cause of death in the world, second to respiratory infection during childhood. In 2009 diarrhea was estimated to have caused 1.1 million deaths in people aged 5 year and over and 1.5 million deaths in children under the age of 5yr.[9] In developing country like India, its occurrence rate is more in children due to poor hygienic maintenance, illiteracy of parents, inadequate feeding and increase in population. Hence it is more emphasized because its leading complications are malnutrition and death.

Diarrhea is still a significant child health problem because–Families pay high price to care for children with diarrhea in terms of money, time and lost opportunities and childhood diarrhea is costly burden on national health care system. Causative agent of acute diarrhea can now be identified in 70 to 80% of acute diarrhea, but it needs sophisticated laboratories. Large majority of acute diarrhea episodes can be managed effectively even in absence of laboratory investigation. While treating diarrhea, we cannot prescribe a specific medicine from modern medicine because antimicrobials are indicated in high grade fever, bloody, mucoid, greenish, foul smelling stools and severe toxemia.[10]

Anti-motility agents like loperamide and Diphynoxylate hydrochloride have no role in the management of acute watery diarrhea. Binding agents like pectin, kaolin and bismuth are only for psychological reassurance; they do not decrease the losses. Antisecretory agents like Racecadotril and enkephalinase inhibitor, reduces stool out-

put but it is unnecessary in child with acute diarrhea.

Also, medications such as antibiotics and antidiarrheal agents are generally not necessary and could be harmful for infants and children with diarrhea. Rarely, antibiotics may be used in cases of bacterial infection when specific cause of diarrhea has been found or is strongly suspected, particularly after recent travel. Inappropriate use of antibiotics will not improve diarrhea. Furthermore, antibiotics can cause side effects and lead to development of antibiotic resistance.

Musta is one of the remedy in the treatment of *diarrhea* described by Acharyas.[11, 12, 13, 14] *Musta* an easily available drug. One of the synonyms of *Musta* is *Ambudhara* which indicates its use in diarrhea.[15] It has no adverse effect; hence experimental group was treated with *Musta kwatha*. In Ayurveda, *honey* is considered as best *vehicle along with drugs* due to its *synergestic* property.[16] *Madhu* is best *kaphashamak dravya*.[17] Maximum diseases occurring in children are due to vitiation of *Kapha dosha*, so *Madhu* is used as *Anupan dravya*. ORT is used for both groups to prevent dehydration and further sequel due to diarrhea. ORT is core of treatment for diarrhea. In infants and children with clinical evidence of some dehydration, oral rehydration therapy is effective in 95 to 97 percent cases.[18]

Patients with only acute diarrhea were selected for study as chronic diarrhea requires special emphasis towards malnutrition due to diarrhea. Children between ages of 6 months to 24 months are selected for study, as diarrhea is most common in this age group due to dentition and weaning. Children free from any other systemic illness are selected, as they will require other management protocols too.

As severe dehydration requires emergency medical treatment and intravenous fluid therapy, children with severe dehydration are excluded from study. After evaluating the values statistically, following results are obtained. In sex wise distribution, when both groups were statistically compared by applying chi-square test, chi-square value is 0.069 and table value is 3.84. It means the test is insignificant and $p>0.05$. This suggests that both groups are homogenous at baseline. Hence distribution is common in both groups equally. In age wise distribution, when groups were statistically compared by applying chi-square test, chi-square value is 0.069 and table value is 3.84 it means the test is insignificant and $p > 0.05$. This shows both groups are homogenous for Age-wise distribution. In religion wise distribution, 19 patients were from Hindu community, 5 patients from Muslim and 6 from other community in "Experimental group" and 20 patients from Hindu, 5 from Muslim and 5 from other community in "Control group", which shows equal homogenous distribution in both groups.

In distribution according to socio-economic status when both groups were compared by applying chi-square test, shows homogeneity in distribution. Data suggested that it is common in low and medium socio-economic class as no patient is observed from higher class.

In distribution according to sanitary condition when both groups were compared by applying chi-square test shows homogeneity in distribution. Data suggests that the diarrhea is common in unhygienic peoples.

Frequency of Motion: Mean observed in Experimental group on 1st and 7th day of follow – up of treatment are 2 and 0.167 and that of control group are 2 and 0.600 when compared by unpaired 't' test it is

significant at P =0.05 significant level. It means there is better effect of *Musta kwatha + honey* with ORT over reducing frequency of motion than control group in which only ORT is used.

Mean observed on 3rd and 5th day of treatment of Experimental group are 1.367 and 0.600 respectively while that of control group are 1.700 and 0.967 respectively which suggests that Experimental group shows better results over frequency of motion in diarrhea throughout whole treatment.

Degree of Dehydration: Mean of degree of dehydration observed in both groups on 1st and 7th day of treatment are 0.933 and o respectively when compared with unpaired't' test, it is insignificant. It means there is no difference in both groups treatment i.e. both treatments are equally effective. Mean of degree of dehydration on 3rd day of Experimental and control group are 0.4 and 0.567 respectively, it means comparison shows better effect in Experimental group than control group. Also mean on 5th day of experimental and control group are 0.167 and 0.267 after comparing shows more effect in Experimental group than Control group.

When both groups are compared by chi-squre test for effectiveness of treatment experimental group shows significant result over given parameters than control group though both treatments are effective on childhood diarrhea.

Probable Mode of Action- Modern View: Researchers studied the effect of decoction of *Cyperus rotundes* on adherence (in vivo) and enterotoxin production (in vivo) in enteropathogenic and enterotoxigenic E.coli. Results indicate that while the extract did not prevent adherence, it inhibits the production of toxins significantly by the different strains of E.coli.[19, 20] The maximum diarrheal episodes in children are due to Rotavirus and E. coli. Cyperus rotundus must have antiviral activity and it also inhibits toxins production by the different strains of E.coli.

CONCLUSION

Diarrhea is a significant child health problem despite intensive efforts at control. The two leading complication of diarrhea are malnutrition and death. Main causative organisms for childhood diarrhea are Rotavirus and E. coli. In infants and children with clinical evidence of some dehydration, oral rehydration therapy is effective in 95 to 97 percent cases. *Musta kwatha* with ORT shows better results for childhood diarrhea as compared to only ORT. *Musta kwatha* with *honey* can be used as effective remedy for childhood diarrhea.

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Source of support: Nil

Conflict of interest: None Declared