Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 6 [12] November 2017 : 79-82

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.876
Universal Impact Factor 0.9804
NAAS Rating 4.95

ORIGINAL ARTICLE **OPEN ACCESS**

A Study on the Antibacterial Effect of Aloe Vera Leaf Extract Compared to That of Standardized Antibiotics Against Bacterial Isolated From Biotech Park Lucknow

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ABSTRACT
The antimicrobial activity of aloe vera extract was tested against pathogenic bacteria like Staphylococcus aureus, Salmonella and E. coli at a different dose of Aloe vera extract. Aloe veraleaf powder was dissolved in sterile water for 24 hours to get the necessary extract from the leaf of this plant. The results expected to reveal that, extract at different dose was shown significant activity against Escherichia coli 25922, Salmonella typhi 14028, staphylococcus aureus43300, staphylococcus aureus25923, Shigellasonnei 25931, Shigella flexnei 12022, Pseudomonas aeruginosa 27853, Enterobacter foecalis 29212, Streptococcus pneumonia 49619, Streptococcus pyogens .The zone of inhibition was measured and compared with standard value of antibiotic discs against these bacteria. At the same time, standard value of Vancomycin(-); pure Aloe vera powder(-) and medium without antibiotic (+) were used as control. Aloe vera is also used in india topically to heal wounds and for various skin conditions, and orally as a laxative. Today, in addition to traditional uses, people take Aloe orally to treat a variety of conditions, including diabetes, asthma, epilepsy, and osteoarthritis, burns, and sunburns gastrointestinal diseases, sexual transmissible diseases, cardiac and respiratory infections. The Food and Drug Administration (FDA) has approved Aloe veraas a natural food flavoring (Natural Medicines Comprehensive Database Web site). This study reveals the importance of natural products to control antibiotic resistant bacteria, which have been a threat to human health. It is, therefore highly essential that medicinal plants whose properties have not been fully characterized should form a top agenda of top management in developing nations whose citizens are sometimes unable to afford expensive orthodox medicine.
Key words: Aloe Vera plant, antimicrobial activity, traditional medicine, leave extracts, Inhibition zone.

INTRODUCTION

Traditional medicine is in practice for many centuries by a substantial proportion of the population of many Countries. It is recognized that in some developing countries, plants are the main medicinal source to treat various infectious diseases. Plant extracts represent a continuous effort to find new compound against pathogens. Approximately 20% of the plants are found in the world have been submitted to pharmacological or biological test, and a substantial number of new antibiotics introduced on the market are obtained from natural or semi synthetic resources [1]. African traditional medicine is generally recognized as being organized into three levels of specialty [2]. These areas, which may overlap in some cases, are divination, herbalism, and spiritualism. The spiritualist is generally identified with a political role and public health duties; the diviner and herbalist are more involved with health delivery to the individual in traditional society. The diviner uses magic and supernatural powers to diagnose and treat diseases with the aid of ancestral spirits who endow amulet, animal parts, or herbs with the power to heal or drive away evil. The herbalist on the other hand applies knowledge attained by empirical observation [3]. This has been for a long time ignored or marginalized. In India, herbalists used to be for rural people. They were not allowed to publicly do their businesses regarding traditional medicines. Nowadays, it has been found that these people are not totally based on traditional powers, but according to the scientific researches there is a significant contribution to the health care or the wellbeing of Indian people in general. For this purpose, they have been allowed accordingly under ministry of health control. This plant

was for a long time cultured for ornamental purposes. In addition to that, its adaptation to any kind of soil contributed a lot to its propagation in India even if the scientific importance was still ignored.
Aloe barbadensis (Aloe vera) has a long history of use as a therapeutic agent with many reported medicinal properties. Amongst its therapeutic properties, it has been shown to have anti-inflammatory activity [4] immune stimulatory activity [5], and cell growth stimulatory activity [6,7]. Furthermore, activity against a variety of infectious agents has been attributed to Aloe vera; for instance, antibacterial [8], antiviral [9] and antifungal [10]. As we move forward, toward the brighter future we must also as scientists, give an important place to traditional healers and try to be specific on what they are making as medicines. In fact, this could help in working hand in hand to fight against different types of diseases, because there are so many which have been left behind according to different researches which are taking place and they are now significant in underdeveloped countries.

MATERIALS AND METHODS

MATERIALS

Plant materials

The plant materials used in this study were aloe vera leaves that were collected from Biotech Park. Lucknow - Uttar Pradesh – INDIA.This was done by cutting them using the knife

Other materials

Petri dishes, conical flask, mortar or a blender (grinder), knife, micropipette, test tubes, test tube holder, incubator, fridge, filter paper, filter, spreader etc.

Bacteria

The tested organisms for this study were: *Escherichia coli 25922, Salmonella typhi 14028, staphylococcus aureus 43300, Staphylococcus aureus25923, Shigella sonnei 25931, Shigella flexnei 12022, Pseudomonas aeruginosa 27853, Enterobacter foecalis* 29212, Streptococcus pneumonia 49619, Streptococcus pyogens .These test organisms used in the study of antibacterial effects of Aloe barbadensis leaf extracts are medical isolates used by NRL lab technician in bacteriology section in quality control and these which are Standard Naïve Bacteria known to be affected by antibiotics.

METHODS

Aloe leaves extraction

Fresh Aloe leaves were collected from the healthy aloe plant Biotech Park greenhouse Jankipuram, Kursi Road, Lucknow -Uttar Pradesh. Cell second one from Central Institute of Medicinal and Aromatic Plants Lucknow -Uttar Pradesh. Aloe powder extraction process was done by washing the aloe leaves with tap water ethanol 70% and sterile water first removing the spines and cut it into small pieces to facilitate the drying step (Figures 1 and 2). Cut leaves were put in an oven at 70ºC for 24 hours. The dried aloe pieces were grind by using a mortar, the obtained powder was soaked in ethanol for 24 hours.

Figure 1: Shading of A.vera leaves

Figure 2: Washing of A. vera leaves

Figure 3: A.vera powder

Figure 4: A.vera powder mixed with methanol

Above figures describe well the process of leaf methanolic extraction. 30g of Aloe verapowder was mixed 100 ml of methanol 80% in a conical flask for 72hours. The last stept were evaporation of methanol in extract using evaporator.

FRESH LEAF AND GEL EXTRACT

Gel extraction

Aloe fresh leaves were collected from the field washed well with the tap water, ethanol 70% and sterile water after removing the spines, envelop them, mortared and pour extract in a sterile bottle. And this was used as such without any modification.

Figure 5: Aloe leaves pieces in a mortar

Figure 6: Aloe fresh green juice

All of these different types of extracts were applied on 10 types of bacteria for antibacterial effect testing. For both extracts serial dilution was done from 1/1; 1/10; 1/100; 1/1000; 1/10000

RESULT

Antimicrobial susceptibility testing

Standard antibiotic discs: ciprofloxacin and chloramphenicol

The most standard antibiotic discs used to kill or inhibit growth of these 10 bacterial strains are ciprofloxacin and chloramphenicol. Action of these antibiotics against these 10 bacteria is shown in diagrams below.

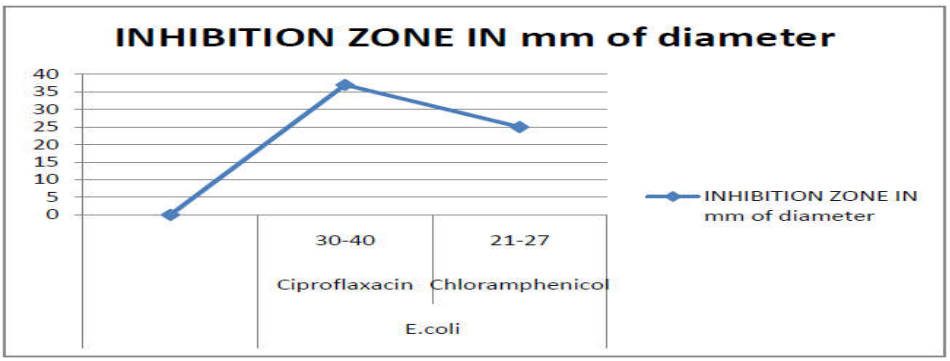

Fig 1: Effect of Chrolomphenicol & Ciproflaxacin against *E.coli*

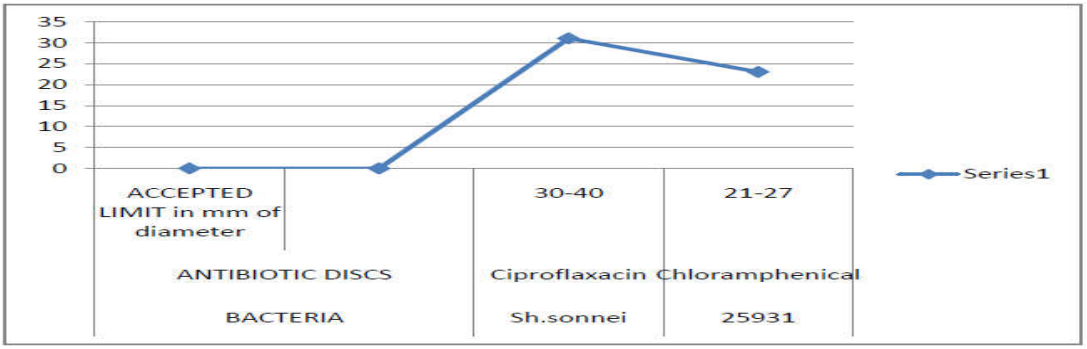

Fig 2: Effect of Chrolomphenicol & Ciproflaxacin against *S.Sonnei*

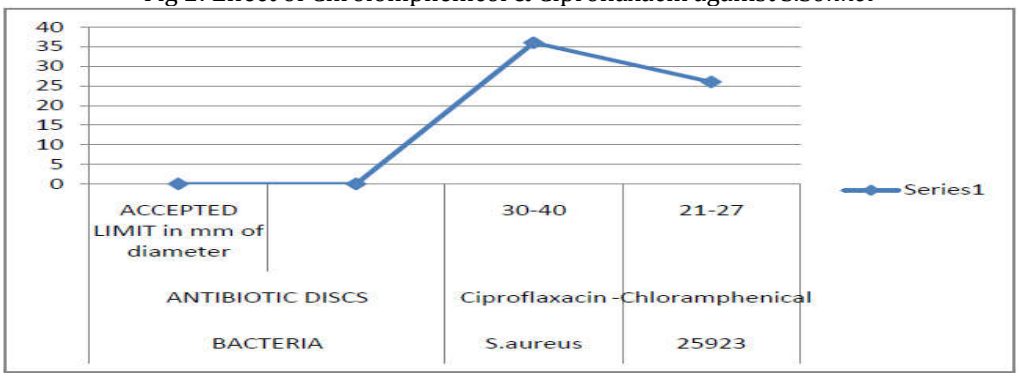

Fig 3: Effect of Chrolomphenicol & Ciproflaxacin against *S.aureus* 25923

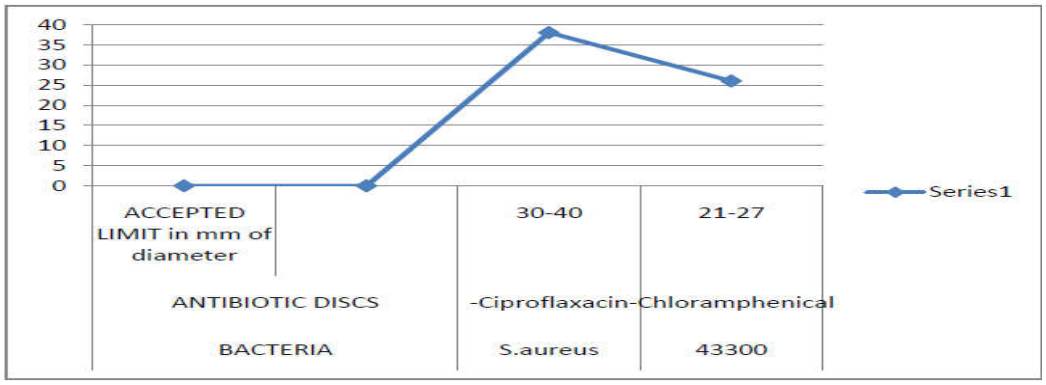

Fig 4: Effect of Chrolomphenicol & Ciproflaxacin against *S.aureus* 43300

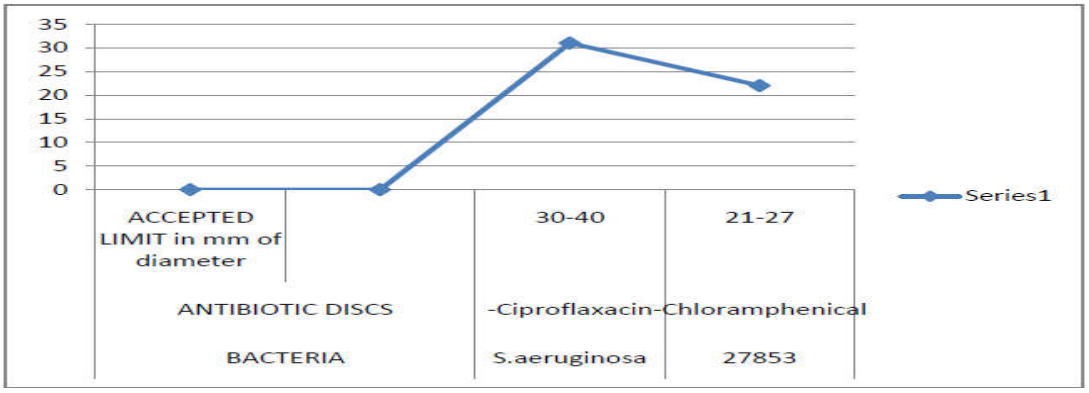

Fig 5: Effect of Chrolomphenicol & Ciproflaxacin against *S.aeruginosa*

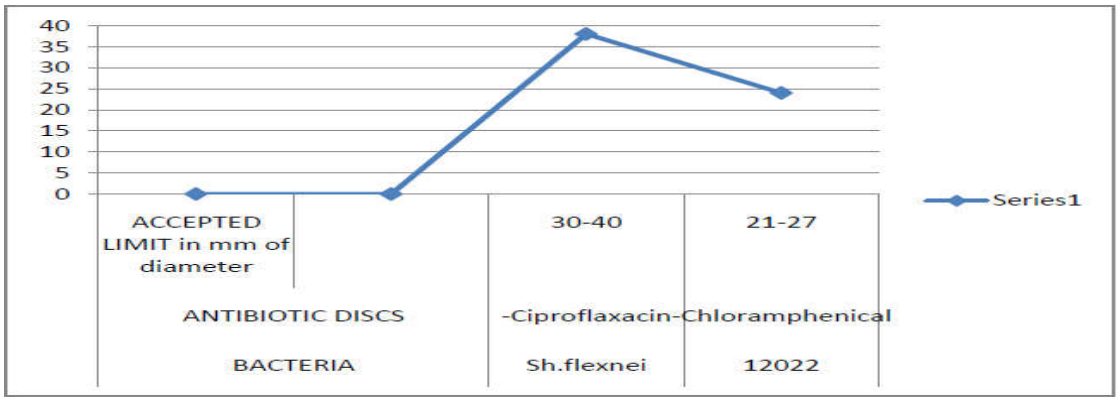

Fig 6: Effect of Chrolomphenicol & Ciproflaxacin against *Sh.flexnei*

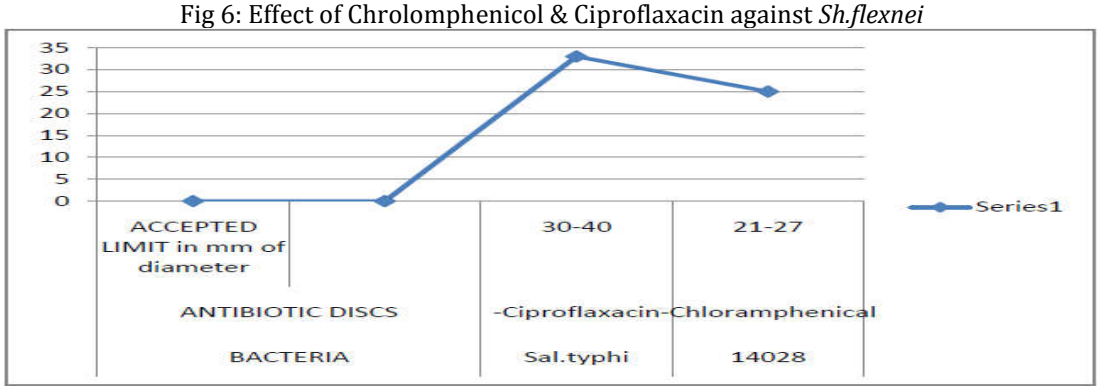

Fig 7: Effect of Chrolomphenicol & Ciproflaxacin against *Sal.typhi*

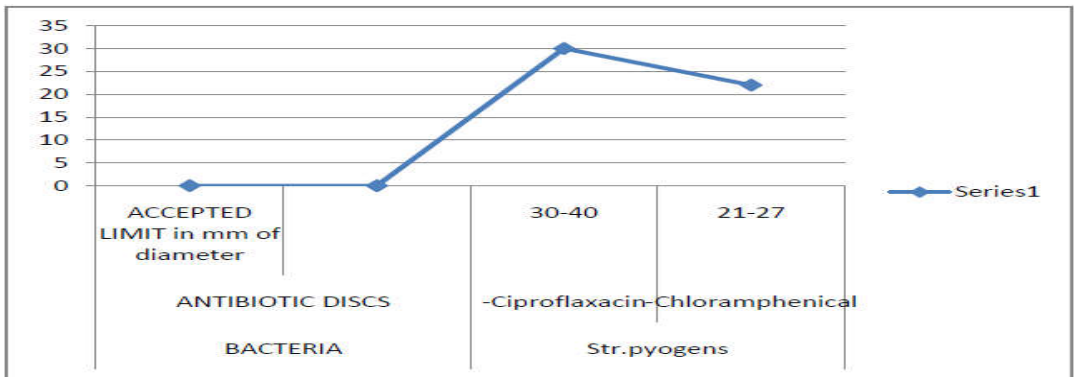

Fig 8: Effect of Chrolomphenicol & Ciproflaxacin against *Str. pyogens*

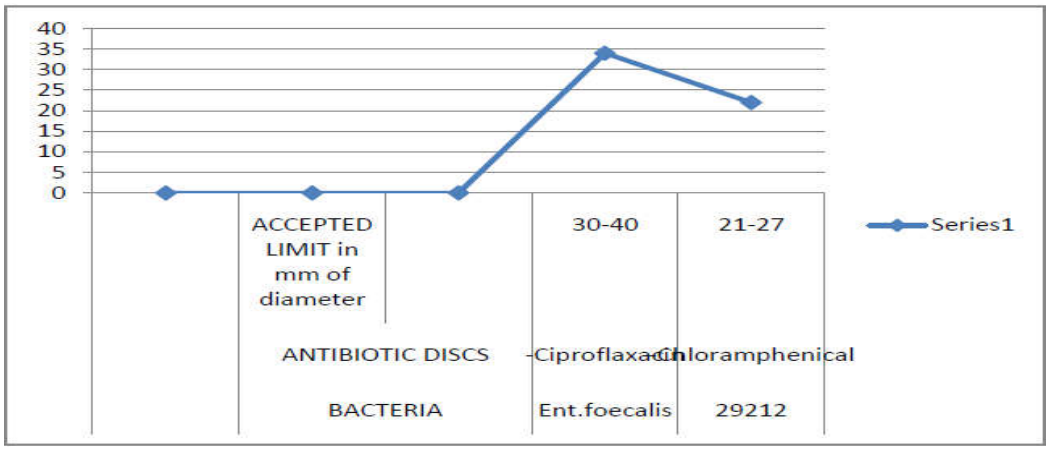

Fig 9: Effect of Chrolomphenicol & Ciproflaxacin against *Ent. faecalis*

Inhibition zones by methanolic leaf extract

As A. vera effects on studied bacteria were observed through the clear zones, some concentrations that were used in this study such as 1/10; 1/100; 1/1000; 1/10000 No inhibition zone observed, is only observed at high concentration (without dilution) Table above summarize result about the diameters measured in millimeters and describes well different concentrations of aloe extract and those of standard antibiotic discs applied on 10 different.

Bacteria Dilution number	Dried *Aloe vera* leaf extract				
	1/1	1/10	1/100	1/1000	1/10 000
E.coli 25922	22mm	0mm	0mm	14mm	20mm
Sh.sonnei 25931	17mm	0mm	0mm	0mm	0mm
Sh.flexnei 12022	15mm	0mm	0mm	0mm	0mm
S.aureus 25923	27mm	0mm	0mm	0mm	0mm
S.aureus43300	28mm	0mm	0mm	0mm	0mm
Ps.aeruginosa 27853	24mm	0mm	0mm	0mm	0mm
Sal.typhi14028	20mm	0mm	0mm	0mm	0mm
Ent.foecalis 29212	26mm	0mm	0mm	0mm	0mm
Strp.pneumoni a49619	23mm	0mm	0mm	0mm	0mm
Strp.pyogens	0mm	0mm	0mm	0mm	0mm

Table 1: Effect of A.vera leave extract against above bacteria

These tested bacteria are highly sensitive to A.vera extract at maximum concentration as it is to standard antibiotic discs as it is shown below by the pictures.
These tested bacteria are highly sensitive to A.vera extract at maximum concentration as it is to standard antibiotic discs as it is shown below by the pictures.
1. Identification of zones of inhibition of dried leaf extract of A.vera against *Staphylococcus aureus*

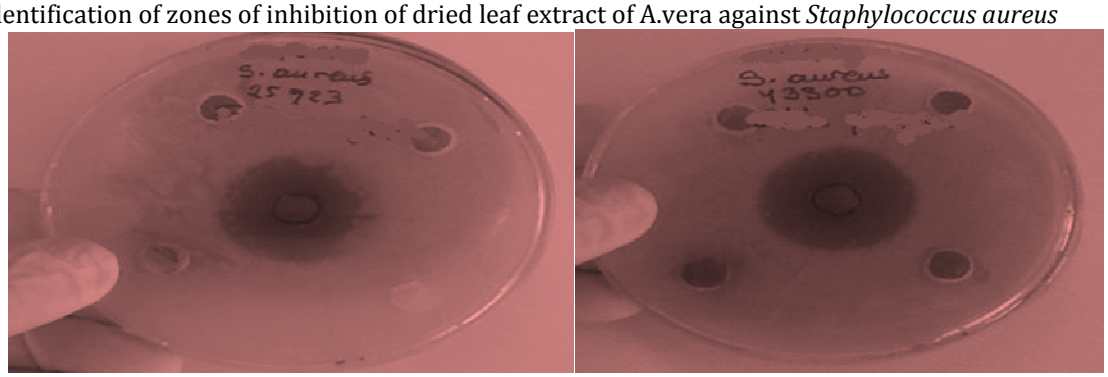

Figure 10: Inhibition zone on *S.aureus* plates

Inhibition zone varied from 27 to 28 mm of diameter.

2. Identification of zones of inhibition of dried leaf extract of A.vera against *Ent.foecalis*and E.coli. Inhibition zone observed was 26mm and 22mm.

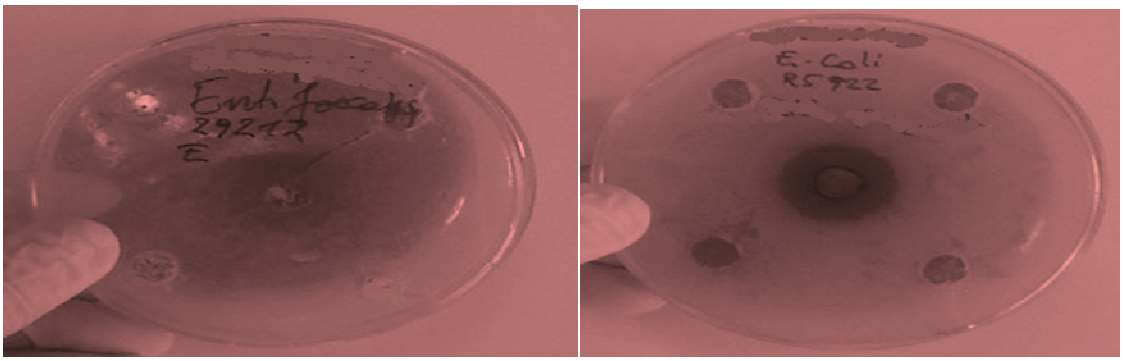

Figure11: TInhibition zone on *Ent.foecalis* and *E.coli*

3. Identification of zones of inhibition of dried leaf extract of *A.vera*against *Sh.flexnei* and *Sh.sonnei*. Inhibition zone observed was 15mm and 17mm of diameter.

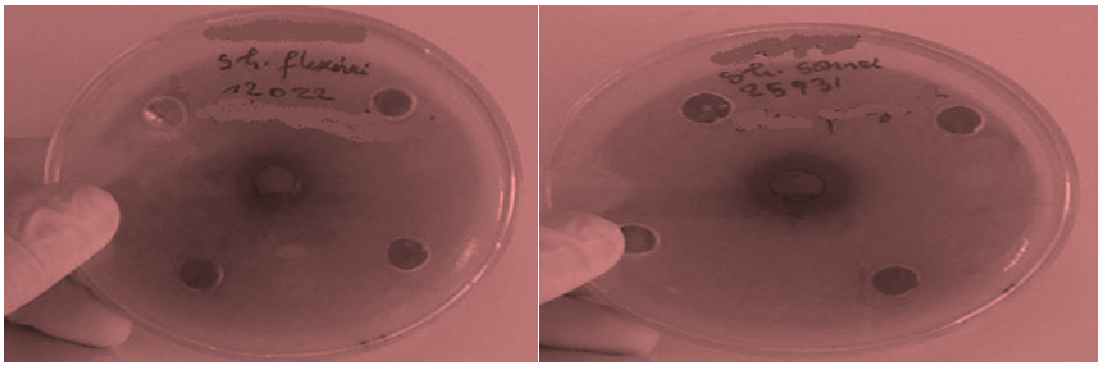

Figure12: Inhibition zone on *Sh,sonnei* & *Sh.flexnei*

Inhibition zone against *Sal.typhi* and *Ps.aeruginosa* were 20mm and 24mm.

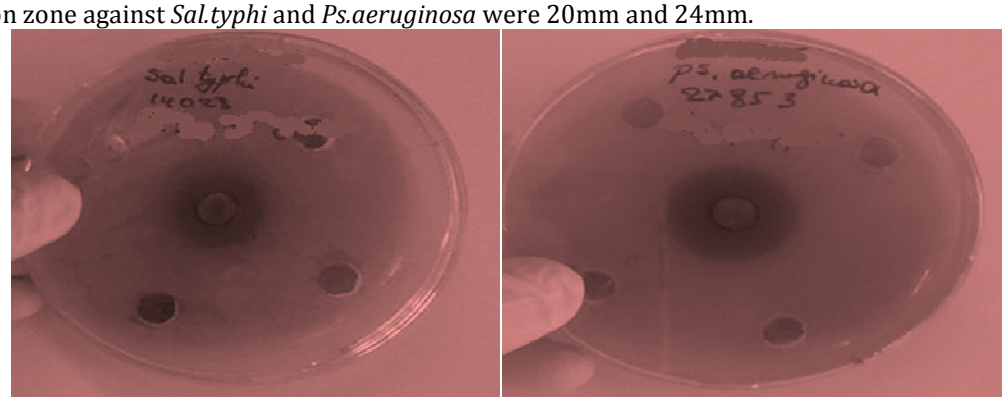

Figure13: Inhibition zone on *Sal.typhi* & *Ps. aeruginoasa*

Inhibition zone against *Str.pneumonia* and pyogens were 23mm and around zero.

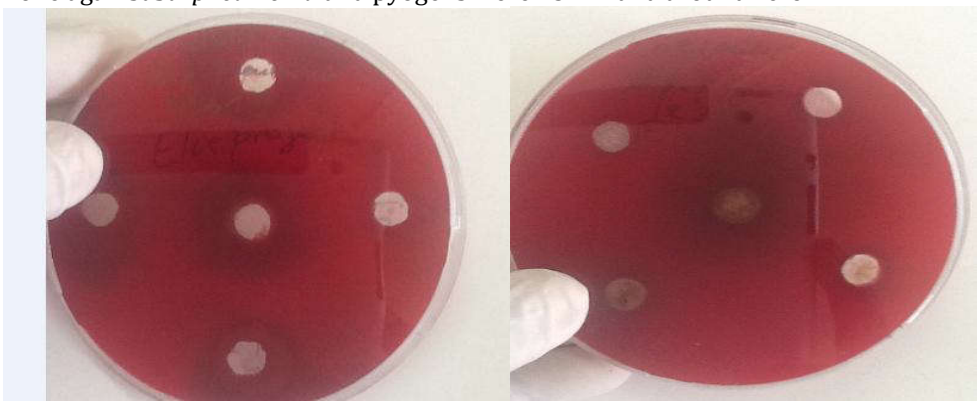

Figure 14: T Inhibition zone on *Str. pyogens* and pneumonia

DISCUSSION

Many researchers have been carried out on this plant specifically on this species, to determine its effect on different bacteria. Compared to for example, the work done by Msoffe and Mbilu in 2009 on the antibacterial effect of *Aloe secundiflora* sp, where the results showed that it has inhibitory effect on *S. aureus* and *Escherchia coli*. The results of this study show that *Aloe barbadensis* leaf extract has inhibitory effect on *S.aureus* (table 1). Among the tested bacteria, Aloe vera possesses greatest inhibitory effect on *S. aureus*. This result could be responsible for the popular use of Aloe leaves to relieve many types of gastrointestinal irritations [11, 12].

Since *S.aureus* form part of the normal microbial flora of the skin, upper respiratory tract and intestinal tract [13, 14]. Also aloe leaf extract showed effect on E coli (both fresh and ethanolic extract), by different zones of inhibition (Fig1, 3, 4). The Aloe "juice "showed inhibitory effect on Staphilococcus and Salmonella, but not on E coli. This can mean the difference between Aloe juice and leaf extract. This may be caused by the heating effect by altering the components. However Aloe gel has an effect only on E coli (Fig 4). As E coli is among the gastrointestinal flora it may not be affected when the Aloe "juice" is administered promote wound. Also healing due to the presence gel is of some components like anthraquinone and some hormones, which possesses antibacterial, antifungal and antiviral activities.

Compared to the work done on this plant (*Aloe barbadenisis* sp.) in Nigeria, by the department of microbiology Federal University of Technology, Akure, Nigeria by Agarry on comparative antimicrobial activities of Aloe gel and leaf, 25mg/ml of the leaf extract and gel applied on *S. aureus* showed respectively inhibitionzones of 18mm and 4mm [15]. On this study's results 4 inhibition zone of 14mm on *S.aureus* while the gel showed nothing on this bacterium.

This may be due to different factors such as plant water content, area and the soil where the plant has been grown, the climate changes etc, as the study was made for the same variety. The growth of Salmonella was also inhibited by A. vera leaf but not affected by the gel. The inhibitory effect of *A. vera* leaf on *S. aureus* growth, gives an explanation on its reputation as a cosmetic plant. The methanolic leaf extract is more effective than the fresh leaf extract and the juice. In all cases where possible, the ethanol extracts of these plants should be used at a concentration up to 400mg/ml (Table 1) so as to give a better treatment margin (MIC).

The difference in antimicrobial properties of a plant extract is attributable to the age of the plant used, freshness of plant materials, physical factors (temperature, light water), contamination by field microbes, adulteration and substitution of plants, incorrect preparation and dosage [16-18].

The use of disk papers was not successful, because wherever disks were applied no inhibition zones were observed. Instead, the wells method was adopted. There were difficulties to the medicine of diffusing on the medium.

CONCLUSION

In conclusion, more work should be also carried out on the leaf to reveal some of its potentials. This study shows that both the gel and leaf are useful and that they can complete one another in their medicinal capabilities. The high activity of the ethanolic extracts verifies the use of the ethanolic extraction method by local herbalists.

REFERENCES

1. Mothana RA and Linclequist V. (2005). Antimicrobial activity of some medicinal plants. J Ethnopharmacol, 96(1-2):177-181.
2. Chavunduka, G. 1994. Traditional medicine in modern Zimbabwe. Harare: University of Zimbabwe Publications. pp. 115.
3. Tylor PW, Hamilton –Miller JMT, Stapleton PD. 2005. Antimicrobial properties of green tea catechins. Food Sci. Technol. Bull.;2:71-81.
4. Malterud, K.E, T.L. Fabrot and A.E. Huse. (1993). Antioxidant and radical scavenging effects of anthraquinones and anthrone. Pharmacology, 47: (Supply 1), 77-85.
5. RamamoorthyL. and Tizard (1998), International immunopharmacology, 4, 1743–1755.
6. Rodriguez F, Baldassarre H, Simonetti J, Aste F, Ruttle JL. (1988) Cervical versus intrauterine insemination of ewes using fresh or frozen semen diluted with Aloe veragel.Theriogenology30(5):843-54.
7. Tizard, I., D. Busbee, B. Maxwell and K. Mc. 1994. Effect of Acemannan, a complex carbohydrate on wound. wounds, 6: 201-209.
8. Ferro VA, Bradbury F, Cameron P, Shakir E, Rahman SR, Stimson WH (March 2003). "In vitro susceptibilities of Shigellaflexneriand Streptococcus pyogenes to inner gel of Aloe barbadensis Miller". Antimicrobial agents and chemotherapy 47 (3): 1137–9.
9. Kahlon JB, Kemp MC, Yawei N, 1991. Aloe vera, its chemical and therapeutic properties. Int J Dermatol. ;30 (10):679–683.

10. Kawai K, Beppu H, Shimpo K, Chihara T, Yamamoto N, Aggatsu T, Ueda H, .Shelton RM,1991. Aloe vera: Its chemical and therapeutic properties. Ken Fern 2007 - Notes from observations, tasting etc at Plants for a Future and on field trips.
11. Foster S, 1999. Aloe vera: the succulent with skin soothing cell-protecting properties. Herbs for Health magazine. Health WorldOnline.<http://www.healthy.net/library/articles/hfh/aloe.htm>
12. Grindlay D, ReynaddsAloe veraphenomenon"T (1986)"The Areview and modern uses of the leaf parenchyma-151.
13. Chees Brough M. 1984. Medical laboratory Manual for tropical Countries. Vol. 11, first edition. Printed and bond in great Britain by university press, Cambridge. pp. 372-391.
14. Chees Brough, M. 2000. District Laboratory Practice in Tropical Countries. Press Syndicate of the University of Cambridge. pp. 132-143.
15. Agarry O.O., 2005. Arican journal of biothechnology vol. 4 (12), pp. 1413-1414.
16. Calixto, J.B. 2000. Efficacy, safety, quality control, marketing and regulatory guidelines for herbal medicines (Phytotherapeutic agents). Braz.J.Med. Biol. Res., 33 (2): 179-189.
17. Okigbo, R.N. and Igwe, D. I. (2007). The antimicrobial effects of Piper guineense„uziza"and Phyllantus amarus„e-benizo"on Candida albicans and *Streptococcus faecalis*. Acta Microbiologicaet Immunologica Hungarica 54 (4): 353-366.
18. Okigbo, R.N. and Omodamiro, O.D. (2006). Antimicrobial Effects of Leaf Extracts of Piegon Pea (CajanusCajan(L.) Millsp.) On Some Human Pathogens. J. Herbs, Spices Medicinal Plants, 12(1/2): 117-127.

Genetic Parameters Studies in Aromatic Rice

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ABSTRACT

The present investigation consists of 38 rice genotypes and the experiment was conducted during Kharif-2015 in Randomized Block Design with three replications. The data were recorded for 11 quantitativecharacters to study genetic variability, heritability and genetic advance. On the basis of mean performance, high grain yield per plant were exhibited by thegenotype Pusa-1460. Analysis of variance among 38 genotypes showed significantdifference for all characters studied. Highest genotypic coefficient of variation (GCV) & phenotypiccoefficient variation (PCV) was observed for grain yield per plant followed by biological yield per plant, panicle length, number of grain per panicle, harvest index, test weight and number of productive tillers per plant indicating that these characterscould be used as selection for crop improvement. On the basis of high estimates of heritability coupled with high genetic advance was observed for plant height, number of productive tillers per plant, panicle length, biological yield per plant, harvest index, test weight and number of grains per panicle indicating predominance ofadditive gene effects and possibilities of effective selection for the improvement of these characters.

Keywords: *Rice, Genetic variability, Heritability and Genetic Advance.*

INTERODUCTION

Rice (*Oryza sativa* L.) is principal food crop of India as well as one of the pivotal staple cereal crops feeding more than one-third of the world's population. Rice is the staple food of about 65% of Indian population. Our rice requirement by the year 2020 is estimated to be around 122 million tons as against the present production of about 100 million tons, thus leaving a gap of about 22 million tons rice. It accounts for about 43% of total food grain production and 46% of total cereal production in the country (FAO 2015). Low productivity of rice in India is a major concern for food and nutritional security of more than 60% population which is dependent on rice. The slogan "Rice is life" is most appropriate for Indian as this crop plays a vital role in our national food security and a means of livelihood for millions of rural people of India. Rice occupies a pivotal place in Indian agriculture and it contributes to 15 per cent of annual GDP and provides 43 per cent calorie requirement for more than 70 per cent of Indians.The country witnessed an impressive growth in rice production due to adoption of semi dwarf varieties coupled with intensive input based management practices. In order to keep peace with growing population the estimated rice requirement by 2025 is about 130 million tones. The success of breeding program depends upon the quantum of genetic variability available for exploitation and the extent to which the desirable characters are heritable Variability refers to the presence of differences among the

individuals of plant population. Variation results due to difference either in genetic constitution of the individual of a plant population or in environment, they have grown. The existence of variability is essential for improvement of genetic material. Selection is also effective when there is significant amount of genetic variability among the individuals in breeding materials. (Sumanth, V. *et al.,* 2017)

MATERIAL AND METHOD

The material for the present investigation consists of 38 rice genotypes were grown in Randomized block design with three replications during *kharif-* 2015 at the Crop Research center, Chirodi of Sardar Vallabhbhai Patel University of Agriculture, Technology, Meerut Twenty five days old seedlings raised in nursery were transplanted at 20 cm x 15 cm spacing. Five representative plants for each genotype in each replication were randomly selected to record observations on days to 50% panicle emergence, days to 50% flowering, days to maturity, plant height, number of productive tillers per plant, panicle length, biological yield per plant, harvest index, test weight, number of grains per panicle and grain yield per plant. The variability was estimated as per procedure for analysis of variance suggested by Panseand Sukhatme (1967). PCV and GCV were calculated by the formula given by Burton (1952).Heritability in broad sense (h2) by Burton and De Vane (1953) and genetic advance were calculated by using the procedure given by Johnson *et al.* (1955).

RESULTS AND DISCUSSION

Genetic variability in any crop is pre-requisite for selection of superior genotypes over the existing cultivars. The analysis of variance for different characters indicated the existence of highly significant differences for all the eleven characters study at 1% level of significance suggesting each and every genotype are genetically divergent from each other and there is ample scope for selection of characters from these diverse sources for yield and its components (Table 1). These findings were in accordance with the findings of Bekele*et al.,* (2013), Sandhya*et al.* (2015),Mishu*et al*., (2015) and Anis *et al*., (2016).A wide range of variance was observed for all the eleven characters. In general the phenotypic coefficient of variance was higher than genotypic coefficient variance for all yield and its contributing characters indicate the influence of environmental factors on these traits. The genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) ranged between (6.097 and 6.386) to (29.062 and 29.949) for days to maturity and grain yield per plant respectively. The highest GCV and PCV was recorded for grain yield per plant (29.062 and 29.949) followed by biological yield per plant (28.647 and 29.054), panicle length (27.964 and 28.571) number of grain per panicle(26.849 and 27.034),harvest index (26.740 and 26.909), test weight (25.906 and 25.968) and number of productive tillers per plant (25.736 and 25.789). Similar results were also reported by Anjaneyulu*etal.,* (2010), Idris*et al.* (2012),Sandhya (2014),Sarma*et al.,* (2015) and Anis *et al*., (2016). Coefficients of variation studies indicated that the estimates of PCV were slightly higher than the corresponding GCV is presenting table-2 among the all traits and high values of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for these traits suggested the possibility of yield improvement through selection of these attributes. Closely relationship between GCV and PCV was found in all the characters and PCV values were slightly greater than GCV, revealing very little influence of environment for their expression. The amount of genetic variation considered alone will not be of much use to the breeder unless supplemented with the information on heritability estimate, which gives a measure of the heritable portion of the total variation. It has been suggested by Burton and Devane (1953) that the GCV along with heritability estimate could provide a better picture of the amount of advance to be expected by phenotypic selection. Since genetic advance is dependent on phenotypic variability and heritability in addition to selection intensity, the heritability estimates in conjunction with genetic advance will be more effective and reliable in predicting the response to selection (Johnson *et al*., 1955). Heritability in broad sense includes both additive and non-additive gene effects. While, narrow sense heritability includes only additive components (Johnson *et al*., 1955). In the present study, heritability in broad sense was estimated. Highest heritability in broad sense (> 60%)was recorded in the case of test weight (98.900) followed by number of grains per panicle (98.600), plant height (96.000), biological yield per plant (93.300), days to 50% flowering (92.800), days to 50% panicle emergence (92.200), grain yield per plant (92.000), days to maturity (91.100), panicle length (89.700), harvest index (89.100) and number of productive tillers per plant (69.2).The high heritability denotes high proportion of genetic effects in the determination of these traits and can be adopted for improving grain yield. Studied have been reported earlier also by Fiyaz *et al.*[7], Dhanwani *et al*., [6], Sarma *et al.,* [17] and Islam *et al*., [10].Maximum genetic advance expressed as percentage of mean was revealed high (>20%) for number of grains per panicle

(54.925), grain yield per plant (41.633), harvest index (38.392), plant height (26.980), number of productive tillers per plant (25.259), test weight (24.402), biological yield per plant (23.184) and panicle length (21.401). Moderate genetic advance as percentage of mean (10-20%) was observed for days to 50% panicle emergence (16.725), days to 50% flowering (15.645) and days to maturity (11.990).High heritability (h^2) coupled with high genetic advance was observed for plant height, number of productive tillers per plant, panicle length, biological yield per plant, harvest index, test weight and number of grains per panicle. High heritability coupled with high genetic advance for some of these traits have also been reported earlier by Baswaraja *et al*., [3], Rahman *et al.,* [14], Tiwari, [19] and Islam *et al*., [10]. This indicates substantial contribution of additive genetic variance in the expression of these traits and can be more useful in hybridization and selection for higher grain yield and these characters are largely controlled by additive gene action.

Table-1 Analysis of variance (ANOVA) for eleven characters of rice

Source of variation	d. f.	Days to 50% panicle emergence	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of productive tillers per plant	Panicle length (cm)	Biological yield per plant (g)	Harvest index (%)	Test weight (g)	No. of grains per panicle	Grain yield per plant (g)
Replication	2	10.798	6.482	1.719	32.567	2.888	0.893	6.620	1.907	0.023	5.670	2.463
Treatment	37	169.210**	172.264**	161.700**	821.521**	20.619**	27.165**	1015.799**	157.820**	27.131**	5507.418**	427.084**
Error	74	4.636	4.329	5.079	11.149	2.659	0.992	23.508	6.164	0.093	25.487	11.909

*, ** significant at 5% and 1% level, respectively

Table-2 Estimates of variability parameters for eleven characters in rice.

Character	Mean	Range		Coefficient of variation		Heritability % (broad sense)	Genetic advance	Genetic advance (% of mean)
		Lowest	Highest	GCV (%)	PCV (%)			
Days to 50% panicle emergence	87.59	73.00	109.00	8.455	8.805	92.2	14.651	16.725
Days to 50% flowering	94.91	80.00	116.66	7.882	8.182	92.8	14.849	15.645
Days to maturity	118.50	106.66	136.66	6.097	6.386	91.1	14.209	11.990
Plant height (cm)	122.97	86.46	154.56	13.365	13.638	96.0	33.179	26.980
No. of productive tillers per plant	16.60	12.03	22.80	25.736	25.789	69.2	4.194	25.259
Panicle length (cm)	26.93	20.26	32.56	27.964	28.571	89.7	5.765	21.401
Biological yield per plant (g)	156.13	113.73	187.73	28.647	29.054	93.3	36.200	23.184
Harvest index (%)	36.01	23.90	54.06	26.740	26.909	89.1	13.827	38.392
Test weight (g)	25.21	21.00	31.00	25.906	25.968	98.9	6.152	24.402
No. of grains per panicle	159.21	72.40	241.66	26.849	27.034	98.6	87.451	54.925
Grain yield per plant (g)	55.85	33.70	78.33	29.062	29.949	92.0	23.253	41.633

CONCLUSION

In the present investigation which included 38 genotypes of rice was carried out in order to study the nature and amount of variability, heritability and genetic advance for 11 quantitative characters. On the basis of mean performance, high grain yield per plant were exhibited by the genotypePusa-1460.Analysis of variance among 38 genotypes showed significant difference for all characters studied. Highest genotypic coefficient of variation (GCV) &phenotypic coefficient variation (PCV) was observed for number of productive tillers per plant, panicle length, biological yield per plant, harvest index, test weight, number of grains per panicle and grain yield per plant indicating that these characters could be used asselection for crop improvement. High heritability coupled with high genetic advance as percent of mean estimated for plant height, number of productive tillers per plant, panicle length, biological yield per plant, harvest index, test weight, number of grains per panicle and grain yield per plant indicating predominance of additive gene effects and possibilities of effective selection for the improvement of these characters.

REFERENCE

1. Gala, A.,Ayman, E.L., Sabagh,Ghareb, A. and EL-Rewainy, I. (2016).Evaluation of promising lines in rice (*Oryza sativa* L.) to agronomic and genetic performance under Egyptian conditions.*International Journal of Agronomy and Agricultural Research*, 8(3): 52-57.
2. Anjaneyulu, M., Reddy, D.R. and Reddy, K.H.P. (2010).Genetic variability, heritability and genetic advance in rice (*Oryza sativa* L.). *Research on Crops*, 11(2):415- 416.
3. Basavaraja, T., Prasad, G.S., Kumar, B.M.D. and Hittlamani, S., (2013). Correlation and path analysis of yield and yield attributes in local rice cultivars (*Oryza sativa* L.). *Journal of Plant Breeding*, 2(4):523-526.
4. Bekele, B.D., Rakh, S., Naveen, G.K., Kundur, P.J. andShashidhar, H.E. (2013).Estimation of geneticvariability and correlation studies for grain zinc concentrations and yield related traits in selected rice(*Oryza sativa* L.) genotypes. *Asian Journal of Biological Sciences*, 4(3):391-397.
5. Burton, G.W., De Vane, EH. (1953). Estimating heritability in tall fesscusce from Replicated clone natural materials. *Agronomy Journal*, 45:171-181.
6. Dhanwani, R.K., Sarawgi, A.K., Solanki, A. andTiwari, J.K. (2013).Genetic variability analysis forvarious yield attributing and quality traits in rice (*Oryza sativa* L.).*The Bioscan*, 8(4):1403-1407.
7. Fiyaz, R.A., Ramya, K.T., Chikkalingaiah, B.C.A., Gireesh, C. and Kulkarni, R.S.(2011).Geneticvariability, correlation and path coefficient analysis studies in rice (*Oryza sativa* L.) under alkaline soil condition. *Electronic Journal of Plant Breeding*, 2(4):531-537.
8. Food and Agricultural organization (2015).Online Interactive Database on Agriculture,*FAOSTAT.*
9. Idris, A.E., Justin, F.J., Dagash,Y.M..I. andAbuali, A.I. (2012). Genetic variability and inter relationship between yield and yield components in some rice genotypes. *American Journal of Experimental Agriculture,* 2(2):233-239.
10. Islam, M.Z., Khalequzzaman, M.,Bashar, M.K., Ivy, N.A.,Haque, M.M. and Mian, M.A.K.(2016). Variability Assessment of Aromatic and Fine Rice Germplasm in Bangladesh Based on Quantitative Traits. Hindawi Publishing Corporation *The Scientific World Journal*, Article ID 2796720.
11. Johnson, R.E., Robinson, H.W. and Comstock, H.F. (1955).Estimates of genetic and environmental variability in soyabeans.*Agron. J*. 47: 314-318.
12. Kaosar, M.M.F.,Rahman,W.Md., Azad, M.A.K., Biswas, B.K.,Talukder, Md. A.I.,Kayess, Md. O., Islam, Md. R. and Alam, Md. R. (2015). Study on Genetic Variability and Character Association of Aromatic Rice (*Oryzasativa* L.).*International Journal of Plant & Soil Science,*9(1): 1-8.
13. Panse, V.G., Shukhatme, P.V. (1967). Statistical Methods for agricultural workers, 2nd edition, ICAR, New Delhi; 152-157.
14. Rahman, M.M., Syed, M.A., Akter, A., Alam, M.M. and Ahsan, M.M., (2014). Genetic variability, correlation and path coefficient analysis of morphological traits in transplanted Aman rice (*Oryza sativa* L.). *American Eurasian Journal of Agricultural & Environmental Sciences,*14(5):387-391.
15. Sandhya, Alok, K., Rngare, N.R., Vidyakar, V. (2015).Study of genetic variability of Indian andexotic rice germplasm in Allahabad agroclimate.*The Bioscan*, 8(4):1345- 1350.
16. Sandhya, Babu, S.G., Kumar, R. (2014).Genetic Variability, Interrelationship and Path Analysisfor Yield Improvement of Rice Genotypes.*The Bioscan,* 9(3):1161-1164.
17. Sarma, M.K., Goswami, R.K., Sharma, A.K. Baruah, M., Sarma, D. and Neog, P., (2015). Genetic variability and diversity in indigenous rice germplasm of assam under aerobic condition. *Prog. Agric.,* 15(1):66-70.
18. Sumanth, V., Suresh, B.G., Jalandhar, B., Ram and Srujana, G. (2017). Estimation of genetic variability, heritability and genetic advance for grain yield components in rice (*Oryza sativa* L.) .*Journal of Pharmacognosy and Phytochemistry*, 6(4): 1437-1439.
19. Tiwari, R., Suresh, B.G., Mishra, V.K., Kumar, A., Kumar, A. (2011). Genetic variability and character association in direct seeded upland rice (*Oryza sativa* L.). *Environment and Ecology,* 29(4):2132-2135.