Comparing the Deodorization Efficiency of Saccharomyces Cerevisiae and Lactobacillus Caseiin in Biodegradable Waste

Nafeesa Kulsoom S[1], S Suji[2*]

[1]Research Scholar, Saveetha School Of Engineering, Saveetha Institute Of Medical And Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India, Pincode: 602105.

[2*] Project Guide, Corresponding Author Saveetha School Of Engineering, Saveetha Institute Of Medical And Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India, Pincode: 602105.

ABSTRACT

Aim: In this research, the potential application of *Saccharomyces cerevisiae* is compared with *Lactobacillus casei* for its novel deodorization capacity on 6 different types of waste samples. **Materials and methods:***Saccharomyces cerevisiae* and *Lactobacillus casei*were used to treat waste samples. Nessler's reagent was used to estimate the ammonium nitrogen present and UV-visible spectroscopy was used to calculate the percentage of ammonium nitrogen reduced after treatment in both the groups. Using clinicalc.com, sample size was determined as N=24 for each group utilizing the existing literature with an alpha error-threshold of 0.05 and 95% confidence interval, G power of 80%, and an enrolment ratio at 1. **Results:** The results show that *S. cerevisiae* reduced the amount of ammonium nitrogen by 22.5%, 9.7%, 7.7%, 12.9%, 5.2% and 7%, where as*L. casei*reduced the amount of ammonium nitrogen by 11.7%, 8%, 5%, 11.3%, 6.1% and 3.8% for cattle waste, poultry waste, fish waste, manure waste, vegetable waste and mixed waste respectively. ANOVA using SPSS version 28revealed that both the pairs are statistically significant with p value <0.001. **Conclusion:** By treating different types of waste samples with *S. cerevisiae* and *L. casei*, the reduction of ammonium nitrogen was successfully evaluated and *S. cerevisiae* was found to be more prominent, suggesting that it could be used as a possible deodorizer in odor management.

Keywords: Novel Deodorization, Ammonium Nitrogen, *Saccharomyces cerevisiae,Lactobacillus casei*, Biodegradable Waste, Organic Compounds, Odor Management.

INTRODUCTION

Recent reviews propose that the developing nations are confronting a challenging issue because of the increased food wastage and its inappropriate handling causing sanitary issues . The expanding world population has an effect in food wastage subsequently being a possible reason for increasing the emission of greenhouse gases. The majority of food wastes are being dumped in landfills as a part of municipal solid waste . Food wastes contribute to major organic compounds which are transformed to compost by a process known as composting thereby serving as essential nutrients . Composting of these organic matter results in the generation of gases like ammonia, methane, volatile organic compounds etc, among which ammonia is a potential odor producing, irritant and toxic gas (Wang and Zeng 2018). Biodegradation is a process in which

organic matter is converted into compost, resulting in the emission of odorous substances such as ammonia, hydrogen sulfide, volatile fatty acids etc that cause air pollution and affecting mainly the sanitary workers who are in close contact with these municipal waste and are exposed regularly. The severe health issues caused due to the inhalation of such pollutants makes the job of sanitary workers highly challenging and demanding . The accumulation of odor producing compounds is due to the biodegradation of food wastes from solid municipal waste that causes a significant level of strong odor . The effective waste management should affiliate with effective odor management inorder to reduce the nuisance caused to common people and sanitary workers . Probiotics are active and live microorganisms that stimulate the growth of other organisms resulting in beneficial characteristics to humans (Gupta and Garg 2009). Probiotic organisms are found to reduce organic compounds to non odorous substances serving as a potential deodorant . Previously our team has a rich experience in working on various research projects across multiple disciplines(Balusamy et al. 2020; Arvind and Jain 2021; Zhao et al. 2020; Hani et al. 2020)

193 and 1060 research articles were published in science direct and google scholar respectively. This study focuses on the novel deodorization potential of probiotics. (Park et al. 2019) studied the removal of trimethylamine which is a major odorous component of fish using S.cerevisiae from fermented food that showed 32.02% to 50.43% reduction of TMA. analysed how yeast fermentation reduced the fishy odor on tilapia enzymolysis solution and found fermented yeast has a good novel deodorization effect. studied the deodorization activity of two yeast strains and found that when both the strains were treated together, the reduction of ammonia was 35.6% - 68.7% which was higher than the yeast strains that were treated separately. compared the two recombinant yeast strains based on concentration of yeast extract for the reduction of ammonia gas and stated that the reduction rate is good even at low concentration.(Lee et al. 2016)

The difficulties faced by the sanitary workers while managing these municipal waste is alarming. This odor emission makes the job highly risky thereby causing labour shortage (Tiwari 2008). Our team has no experience in this field. The aim of this research is to focus on exploring probiotics in the field of novel deodorization and to compare two different organisms for their deodorization potential.

MATERIALS AND METHODS

This comparative study was carried out in the microbiology laboratory of Saveetha School of Engineering. The sample size was estimated using the previously recorded datas by (Kim et al. 2019) in clincalc.com by keeping the g power as 80%. Sample size was determined as N=24 for each group utilizing the existing literature with an alpha error-threshold of 0.05 and 95% confidence interval.

Two different groups were compared in this study. The first group is the samples treated with the organism *S. cerevisiae* and the second group is the

samples treated with the organism *L. casei*. Different types of biodegradable waste samples were collected from different places. The samples were sun dried, powdered and sieved to make it fine. To each 30 g of sample, 3 g of glucose and 250 ml of distilled water was added to make it a slurry. The slurry sample was then mixed for 30 mins using a magnetic stirrer plate. The mixture was then centrifuged at 4500 rpm for 10 minutes and the supernatant was collected. The collected supernatant was again filtered using whatman filter paper. The sample was then filled in falcum tubes to 15 ml mark and autoclaved. 2 ml of the test organisms were inoculated to the waste sample separately and blank samples were not treated with any organism. The samples were then kept in a shaking incubator at 37°c for 7 days.

Nessler's method

After 7 days, to each 5 ml of sample one drop of 0.5 M of EDTA was added and then 0.2 ml of Nessler's reagent was added. The sample was incubated at room temperature for 15 minutes. Optical density values were recorded for the samples at 420 nm using UV-visible spectroscopy.

Statistical Analysis

The statistical software used was IBM SPSS version 28.0.0.0. The independent variables are the waste samples and the dependent variables are the % of ammonium nitrogen, The analysis was done for mean, standard deviation, standard error using one way ANOVA .

RESULTS

Chemical analysis of the treated (deodorized) waste samples showed decreased ammonia level. This might be due to the consumption of nitrogenous compounds by the microorganisms, followed by the generation of ammonia. The ammonia gas might be generated because of the rise in pH or microbial deamination. The strains of *S. cerevisiae* and *L. casei* in the seed culture worked as deodorizing microorganisms.

ANOVA analysis was performed and it is represented in Table 1 which shows the number of samples, mean, standard deviation and standard error. Table 2 represents that both the pairs are statistically significant with p value (<.001) for the reduction of ammonium nitrogen. The study was conducted with 95% confidence interval of the difference. Figure 1 demonstrates the comparative analysis between *S. cerevisiae* and *L. casei* for its reduction of ammonium nitrogen on waste samples which showed that *S. cerevisiae* reduced more efficiently than *L. casei.*

DISCUSSION

In this comparative study, the amount of ammonium nitrogen was more actively reduced by *S. cerevisiae* than *L. casei*. The results show that *S. cerevisiae* reduced the amount of ammonium nitrogen by 22.5%, 9.7%, 7.7%, 12.9%, 5.2% and 7%, where as*L. casei* reduced the amount of ammonium nitrogen by 11.7%, 8%, 5%, 11.3%, 6.1% and 3.8% for cattle waste, poultry waste, fish waste, manure waste, vegetable waste and mixed waste respectively. Among these *L. casei* was slightly more effective for vegetable waste samples showing 6.1% reduction. This clearly shows that *S. cerevisiae* was more effective comparitively.

The study by showed that *S. cerevisiae* reduced ammonia to 10.2% in swine manure which was lesser than the reference strains used and can be utilized for odor reduction industry. compared three microbial strains for its odor removal on a seaweed that had strong fishy odor and found out that upon fermentation *S.cerevisiae* was the best in reducing the odor intensity. The experiment by in making a novel cooking wine by fermentation with microbes such as *S. cerevisiae* was found to evaporate the odorous compounds thereby deodorizing by 80.2% to 88.9% from 4 fishes. studied 2 different yeast strains that were used together on the decomposing waste egg to decrease the malodorous effect and found that both together reduced the ammonia gas emission by 66.7%. The above studies concluded that *Saccharomyces sp* have good deodorizing properties.

The turbidity of the sample after the incubation period was challenging since it can deviate the OD value which will result in the inappropriate reading for ammonium nitrogen reduction. The results from this study will provide researchers with more information about *S. cerevisiae* having deodorization activity of biodegradable wastes and will give insight about it to explore more.

CONCLUSION

By treating different types of waste samples with *S. cerevisiae* and *L. casei*and comparing the deodorization potential of the strains, the reduction of ammonium nitrogen was successfully evaluated. *S. cerevisiae* was found to be more prominent, suggesting that it could be used as a possible deodorizer in odour management.

DECLARATION

Conflict of interest

No conflict of interests in this manuscript.

Author contributions

Author NK was involved in sample collection, inoculum preparation, data analysis and manuscript writing. Author SS was involved in processing the idea, data verification and critical review of the manuscript.

Acknowledgements

The authors would like to express their gratitude towards Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences (Formerly known as Saveetha University) for providing the necessary infrastructure to carry out this work successfully.

Funding: We thank the following organizations for providing financial support that enabled us to complete the study.

1. QBIOGEN LLP, Chennai, India.
2. Saveetha University.
3. Saveetha Institute of Medical and Technical Sciences.
4. Saveetha School of Engineering.

REFERENCES

1. Arvind, Prasanna, TR, and Ravindra Kumar Jain. 2021. “Skeletally Anchored Forsus Fatigue Resistant Device for Correction of Class II Malocclusions-A Systematic Review and Meta-Analysis.” *Orthodontics & Craniofacial Research* 24 (1): 52–61.
2. Balusamy, Sri Renukadevi, Haribalan Perumalsamy, Karpagam Veerappan, Md Amdadul Huq, S. Rajeshkumar, T. Lakshmi, and Yeon Ju Kim. 2020. “Citral Induced Apoptosis through

Modulation of Key Genes Involved in Fatty Acid Biosynthesis in Human Prostate Cancer Cells: In Silico and In Vitro Study." *BioMed Research International* 2020 (March): 6040727.

3. Gupta, V., and R. Garg. 2009. "Probiotics." *Indian Journal of Medical Microbiology* 27 (3): 202–9.
4. Hani, Umme, Mohamed Rahamathulla, Riyaz Ali Osmani, Honnavalli Yogish Kumar, DeeparaniUrolagin, Mohammad Yousuf Ansari, Kamal Pandey, Keerthana Devi, and Sabina Yasmin. 2020. "Recent Advances in Novel Drug Delivery Systems and Approaches for Management of Breast Cancer: A Comprehensive Review." *Journal of Drug Delivery Science and Technology* 56 (April): 101505.
5. Kim, Jung-Ae, Joel Bayo, Juncheol Cha, Yeon Jae Choi, Min Young Jung, Dae-Hyuk Kim, and Yangseon Kim. 2019. "Investigating the Probiotic Characteristics of Four Microbial Strains with Potential Application in Feed Industry." *PloS One* 14 (6): e0218922.
6. Lee, Chang Hoon, Yong Ho Lee, Jae Hong Yoo, Jun Young Park, and Myoung Yong Shim. 2016. "The Malodor Decreasing Effect of Saccharomyces cerevisiae on Decomposing Waste Egg." *Korean Journal of Environmental Biology* 34 (3): 177–82.
7. Park, Seul-Ki, Jae-Hwa Lee, Du-Min Jo, Min-Gyun Kang, Yu-Mi Jang, Yeon-Jin Cho, Dong-Lee Hong, and Young-Mog Kim. 2019. "Reduction of Trimethylamine by Saccharomyces cerevisiae Isolated from Fermented Food." *Korean Journal of Fisheries and Aquatic Sciences* 52 (2): 121–26.
8. Tiwari, Rajnarayan R. 2008. "Occupational Health Hazards in Sewage and Sanitary Workers." *Indian Journal of Occupational and Environmental Medicine* 12 (3): 112–15.
9. Wang, Shuguang, and Yang Zeng. 2018. "Ammonia Emission Mitigation in Food Waste Composting: A Review." *Bioresource Technology* 248 (Pt A): 13–19.
10. Zhao, Yuanzheng, Minyan Dang, Wenzhi Zhang, Yan Lei, Thiyagarajan Ramesh, Vishnu Priya Veeraraghavan, and Xunyao Hou. 2020. "Neuroprotective Effects of Syringic Acid against Aluminium Chloride Induced Oxidative Stress Mediated Neuroinflammation in Rat Model of Alzheimer's Disease." *Journal of Functional Foods* 71 (August): 104009.

TABLES AND FIGURES

Table 1: ANOVA analysis showing the number of samples, mean, standard deviation and standard error.

Descriptives

					95% Confidence Interval for Mean			
	N	**Mean**	**Std.**	**Std.**	**Lower**	**Upper**	**Minimu**	**Maximu**

				Deviation	Error	Bound	Bound	m	m
Saccharomyces cerevisiae	**Cattle**	4	22.5325	1.54165	0.77083	20.0794	24.9856	21.13	24.73
	Poultry	4	9.7	1.44224	0.72112	7.4051	11.9949	8.56	11.81
	Fish	4	7.79	1.34762	0.67381	5.6456	9.9344	6.95	9.8
	Manure	4	12.9325	1.75428	0.87714	10.1411	15.7239	11.05	15.29
	Vegetable	4	5.2875	1.23818	0.61909	3.3173	7.2577	4.24	6.93
	Mixed	4	7.085	1.3518	0.6759	4.934	9.236	5.84	8.53
	Total	24	10.8879	5.98759	1.22221	8.3596	13.4163	4.24	24.73
Lactobacillus casei	**Cattle**	4	11.7875	1.04302	0.52151	10.1278	13.4472	11.03	13.33
	Poultry	4	8.0125	1.00344	0.50172	6.4158	9.6092	7.12	9.42
	Fish	4	5.0675	1.03523	0.51761	3.4202	6.7148	4.04	6.34
	Manure	4	11.3775	1.06099	0.53049	9.6892	13.0658	10.65	12.95
	Vegetable	4	6.125	1.01448	0.50724	4.5107	7.7393	5.15	7.45
	Mixed	4	3.835	1.24079	0.6204	1.8606	5.8094	2.57	4.93
	Total	24	7.7008	3.22555	0.65841	6.3388	9.0629	2.57	13.33

Table 2: Anova showing statistically significant with p value (<.001) for the reduction of ammonium nitrogen. The study was conducted with 95% confidence interval of the difference.

ANOVA						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Saccharomyces cerevisiae	**Between Groups**	786.447	5	157.289	74.247	<.001
	Within Groups	38.132	18	2.118		
	Total	824.579	23			
Lactobacillus casei	**Between Groups**	218.713	5	43.743	38.254	<.001
	Within Groups	20.583	18	1.143		
	Total	239.296	23			

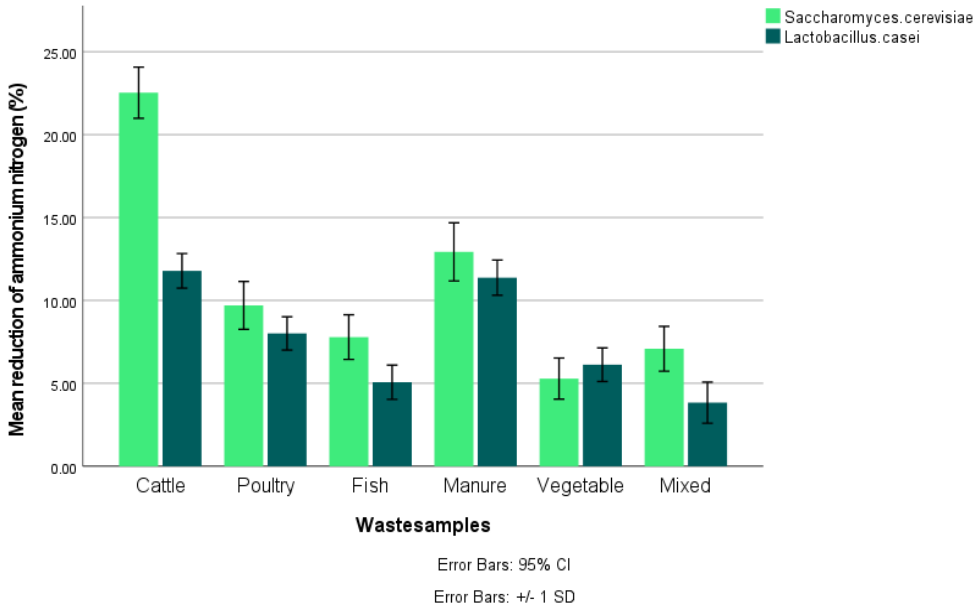

Fig. 1. The bar chart compares the reduction of ammonium nitrogen in terms of percentage between *Saccharomyces cerevisiae* and *Lactobacillus casei.* X axis: Types of waste samples. Y axis: Mean value for the reduction of ammonium nitrogen +/- 1 SD.