RESEARCH ARTICLE

Journal of Extension Education
Vol. 35 No.1, 2023
DOI: https://doi.org/10.26725/JEE.2023.1.35.6977-6986

Usage of Selected Botanicals for Grain Flour Storage among Rural Households in Tamil Nadu

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ABSTRACT

Storage of processed grains is a very common and crucial practice for every family, especially those in rural areas of India. This study assessed the usage of botanicals for grain flour storage among the rural families of Tamil Nadu, India. A training intervention was planned and implemented on eco-friendly storage practices in Salem district of Tamil Nadu. A sample of 100 respondents were selected based on their willingness and availability to participate in the intervention programme in randomly selected villages of Salem District . The responses from the trainees before and after the training intervention programme provided insights into the extent of the adoption of eco-friendly storage practices. The assessment indicated a significant change in the knowledge, attitude, and practice (KAP) of rural households. All the respondents gained knowledge and awareness about eco-friendly storage techniques, and the adoption rate was around 50 percent after the training intervention. Participants also began using eco-friendly storage materials such as containers, particularly in stainless-steel. The study suggests that every state department of agriculture, district KVKs, rural development departments and other line departments should take simple steps to improve storage practices of food grains and flour using eco-friendly methods among consumers in their respective areas.

Keywords*: Knowledge; Attitude; Practice; Rural households; Food Grains; Flour; Storage; Tamil Nadu.*

INTRODUCTION

In order to feed nearly 1.5 billion people, India's food grain production must increase to 150 million tonnes by 2040. Thus, more work needs to be put into continuing the campaign to boost food grain output and reduce storage losses. The majority of the nation's food grains, perhaps 65–70% of them, are kept at the farm level in earthen pots, *Gummi*, *Bakhara*, *Kanaja*, *Kothi* and *Sanduka*. These locally built storage buildings are appropriate for keeping grains under conditions unique to their area (Mann, et al., 2016).

When it comes to food storage, both the pantry and the kitchen need a number of canisters and boxes for multiple food items. While plastic boxes are easily available and are comparatively economic, they do more harm than good. Apart from containing toxic elements like BPA, plastic boxes get easily stained and are not microwave friendly. They are also harmful for the

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Submitted: 26.03.2024 **Accepted:** 08.05.2024

environment as they cannot be easily recycled. There are many plastic-free alternatives for storing food ranging from cloth bags to silicone one (Pritt, et.al., 2018). Tamil Nadu is one of the states in India to have a large grain storage infrastructure, thanks to the National Co-operative Grain Storage Project launched in 2023, under which in every block, 2000-tonnes capacity storage godowns are being constructed.

It is imperative to implement comprehensive strategies that not only minimize the quantitative loss of grains but also safeguard the quality and nutritional value of rice. These strategies include improved storage facilities, enhanced pest management techniques and greater awareness about the economic and nutritional consequences of insect infestation in stored rice (Veena, 2015). Use Pitfall traps to check insect infestations on a regular basis and use ash, red soil or clay, common salt and chilli powder for grain storage are the suggested methods of grain storage at household level (Guru et al., 2022). Based on the review of literature, it was found that the existing researches had failed to focus on dissemination of the idea of food grain and grain flour storage using botanicals in the state. Hence, inculcating storage and preservation of grain flours using botanicals among the rural households is crucial. This practice empowers rural households by providing a practical, locally accessible means of improving food security and reducing environmental impact.

Accordingly this study was taken up to assess the usage of botanicals for grain flour storage among the rural families of Tamil Nadu, India. The respondents were participants of a training on eco-friendly storage practices conducted in Salem district of Tamil Nadu. This study would to knowledge dissemination and awareness about sustainable food storage practices using selected botanicals, potentially sparking further research and development in biopest management methods.

The objectives of this study are:

- To study the socio economic profile of the respondents
- To assess the awareness level of the selected rural households on the use of botanicals for the preservation of food grains and grain flours
- To study the food grain flour storage practices among the selected rural households before and after the training and
- To analyze the impact of training on the storage period and storage methods of food grain flour.

METHODOLOGY

This study adopted a longitudinal research design to investigate the awareness created among rural households in Salem District of Tamil Nadu state, a district renowned for grain production and processing. Hence the impact study regarding eco-friendly storage methods for food grain flour was conducted before and after the training intervention in the study area.

Among the nine taluks in Salem District, Sankari *taluk* was randomly selected, which has 40 panchayats and a total population of 2,41,773 according to Census 2011. Devanakavandanur (N = 8,925) and Chinnakavundanur (N = 6,819) villages were selected due to their high population density.

Using Krejcie and Morgan's table for sample size determination, 100 rural households, interested in participating in intervention programmes were selected at random for the training, ensuring a representative cross-section of the population. Data were collected through structured interviews using an interview

schedule. The interview schedule encompassed key variables related to knowledge, attitude and practices, including awareness of eco-friendly storage methods, existing food grain and flour storage practices and factors influencing the adoption of eco-friendly methods. The training programme was conducted to sensitize participants on eco-friendly storage methods, which was done in 3 batches. The training curriculum was formulated based on the findings of a household survey and the test experiment conducted on the effectiveness of selected botanicals to prevent pest and insect attacks during the storage of food grain flour.

The pre-training evaluation was done just before the training programme and the training was planned based on the need assessment conducted as per Table 1. The post-training evaluation was done after one month from the training, as a minimum of one month is essential to knowledge retention for practicing of grain flour preservation and storage in the presence of 5 mentors to judge the quality of food grain flour. Quantitative data obtained from the survey were analyzed using descriptive statistics to assess the level of awareness and storage practices before and after training. Multiple choice questions related to preferential methods of grain flour storage and preservation, dos and don'ts in grain flour storage and preservations were asked to assess the knowledge level of the respondents.

Table 1: Course Content of the Training Programme

Days	Topic	Method / Audio-visual Aids Used
Day 1	Need for foods, food grains in diet, usage of food grains flour, production of food grains in India	Lecture method
Day 2	Importance of storage of food grains flour, storage methods and devices, safe storage techniques	Lectures and demonstration
Day 3	Reasons for losses during storage, types of loss, quality and quantity loss, ways to reduce the storage loss, improvements needed in storage methods and techniques, types of storage problems faced	Lectures, group discussion and pamphlet distribution
Day 4	Insects and pests that affect the storage, basic methods of storage, preparation of container for storage, measure to prevent the insects, pests and moulds	Lectures with group discussions and distribution of pamphlets
Day 5	Creating awareness of botanicals and other eco-friendly methods in food grain flour storage, advantages and use of botanicals in the form of pellets in storing food grains, practical methods of using the pellets in food grain storage.	Lectures cum demonstration, slide shows and booklets

With regard to attitude assessment, 5-point Likert scale was used consisting of statements related to willingness to learn, adopt and practice new preservation and storage practices. To assess practice, the actual practice of grain flour preservation and storage of the respondents were asked and crosschecked with standard procedure and high score was given to relatively similar practices and least for non-preferential practices. Based on the scores obtained, the level of knowledge, attitude and practices was classified into low, medium and high . Inferential statistics, such as chi-square test and logistic regression, were employed to establish associations between variables and factors affecting the adoption of eco-friendly storage practices. Special attention was given to the adoption of botanical mold for food grain flour storage, with a comprehensive analysis of reasons for its adoption or non-adoption.

The study also delved into the challenges and constraints faced by rural households, particularly in terms of time and cost considerations. Ethical considerations were rigorously observed, ensuring informed consent, confidentiality and voluntary participation of the study participants. The study acknowledges its limitations, including sample size and potential biases and suggests avenues for future research in this domain.

FINDINGS AND DISCUSSION

Socio Economic Profile of the Respondents

A majority of respondents (32%) was in the age group of 41-50 years, followed by 51-60 years (30%). There is a relatively lower representation of younger individuals. A significant proportion of respondents (33%) have completed their graduation, while a minimum of 12% have pursued post-graduation. Nearly half of the respondents (46%) have a monthly family income ranging from Rs. 18,001 to Rs. 37,000.

A considerable portion of respondents (27%) had an income level of Rs. 12,001 to Rs. 18,000. Joint families were predominant, constituting 66% of the study respondents. Nuclear families make up 27% of the respondents. A majority of respondents (44%) had spent between Rs. 10,001 and Rs. 20,000 on food.

Storage Period of Food Grain Flour by Selected Rural Households Before and After the Training Programme

The storage period of the food grain flour was examined before and after the training period among the sample respondents and is given in Table 2.

Table 2: Distribution of the selected rural households based on storage period of food grains flour

Food grain flour	Storage period of the selected rural households (n=100)					
	Up to 3 months (%)		3 to 6 months (%)		Above 6 months (%)	
	Before training	After training	Before training	After training	Before training	After training
Bengal gram flour	65	39 (-26)	35	54 (19)	0	7 (+7)
Maida	60	39 (-21)	36	47 (+11)	4	14 (+10)
Rice flour	41	28 (-13)	59	65 (+6)	0	7 (+7)
Wheat flour	39	29 (-10)	61	62 (+1)	0	9 (+9)

Table 2 shows the distribution of the selected rural households based on storage period of food grains flour before and after training. Before training, a majority of households (65%) stored Bengal gram flour for up to 3 months. After training, this percentage decreased to 39%, as there is shift from storage up to 3 months to to 54% after training.

Similar to Bengal gram flour, there was a decrease in the percentage of households storing Maida for up to 3 months after training, from 60% to 39% for Maida as there is shift in the practice, the percentage of households storing Maida for 3 to 6 months increased from 36% before training to 47% after training. Regarding rice flour before training, 41% of households stored rice flour for up to 3 months. This percentage decreased to 28% after training as there was an increase in households storing rice flour for 3 to 6 months after training, from 59% before training to 65% after training. The percentage of households storing wheat flour for 3 to 6 months remained relatively stable before and after training, with 61% and 62% respectively. After training, 9% of households had stored wheat flour for more than 6 months, compared to none before training, which shows the impact of training programme This data underscores the potential for rural communities to embrace more eco-friendly food grain flour storage practices, contributing to a more sustainable approach to food preservation. A similar result was observed in the study made by Yang et al. (2021).

Container Used for Storing Food Grain Flour Before and After Training Programme

Table 3 brings out the distribution of selected rural households based on the container used for food grain flour before and after training.

Table 3: Distribution based on Container used for Food Grain Flour Storage

Food Grain Flour	Container used for Food Grain Flour Storage (n=100)							
	Usage of polythene bag (%)		Usage of plastic container (%)		Usage of stainless-steel container (%)		Usage of food grade plastic container (%)	
	Before training	After training	Before training	After training	Before training	After training	Before training	After training
Bengal gram flour	32	14 (-18)	33	18 (-15)	21	48 (+27)	14	20 (+6)
Maida	31	23(-8)	46	34 (-12)	13	29 (+16)	10	14 (+4)
Rice flour	14	4(-10)	47	26 (-21)	30	47 (+17)	9	23 (+14)
Wheat flour	31	14 (-17)	39	33 (-6)	23	42 (+19)	7	11 (+4)

The data presented in Table 3 showcases the significant shifts in container usage for storing food grain flours before and after the training programme by promoting eco-friendly storage methods. In storage of Bengal gram flour, before training, 32% of households used polythene bags. After training, this usage decreased to 14%. The usage of plastic containers decreased from 33%

before training to 18% after training. Usage of stainless-steel increased from 21% before training to 48% after training. The usage of food-grade plastic containers increased from 14% to 20% after training. In regard to storage of Maida, before training, the majority of households (46%) used plastic containers for storing Maida. After training, there was a decrease to 34%. Usage of polythene bags decreased from 31% to 23% after training. In storage of rice flour, stainless-steel containers saw a slight increase in usage after training, from 13% to 29%. The usage of food-grade plastic containers increased from 10% to 14% after training. Plastic container usage saw a decrease from 26% to 4% after training. Polythene bag usage also decreased significantly from 14% to 4% after training. Usage of food-grade plastic containers increased from 9% to 23% after training. In wheat flour storage, the before and after training data showed most commonly used storage option for wheat flour was plastic containers at 39%. After training, there was a decrease to 33%. Usage of polythene bags decreased from 31% to 14% after training. Stainless steel containers saw an increase in usage from 23% to 42% after training. Usage of food-grade plastic containers increased from 7% to 11% after training.

The overall findings underscore the effectiveness of the training programme in enhancing awareness and encouraging rural households to adopt more sustainable food grain flour storage practices, emphasizing both quality preservation and environmental responsibility.

Assessment of Knowledge, Attitude and Practice Before and After Intervention Programme on Use of Eco-friendly Botanicals to Extend the Shelf Life of Food Grains and Grain Flour

Table 4 brings out the findings on botanicals and eco-friendly methods used for the food grain and grain flour by the selected rural households.

Table 4: Assessment of Knowledge, Attitude and Practice of the selected rural households on Storage Period and Storage Methods of Food Grains and Grain Flours

(n=100)

Assessment Criteria	Scores obtained by the rural households in KAP assessment (%)		
	Level	Before training	After training
Knowledge of grain storage period	Low Medium High	81 19 -	- 3 97
Knowledge of storage method	Low Medium High	75 23 2	- - 100
Knowledge of grain flour storage period	Low Medium High	86 12 2	- - 100

Assessment Criteria	Scores obtained by the rural households in KAP assessment (%)		
	Level	Before training	After training
Knowledge on Grain flour storage method	Low Medium High	64 34 2	- - 100
Attitude towards adopting preservation and storage methods taught	Low Medium High	91 9 -	- - 100
Practice of grain and grain flour storage period	Low Medium High	89 10 1	- - 100
Practice of grain and grain flour storage method	Low Medium High	80 12 8	- - 100

The results of training assessment showed 100 per cent of attainment in knowledge, attitude and practice on grain storage method, grain flour storage period, attitude towards adopting preservation and storage methods taught, practice of grain, grain flour storage period extension and storage methods. Regarding grain storage period, a majority (97 per cent) of rural households showed improvement in knowledge level. This success of the training could be attributed to the training module and other training quality parameters.

Knowledge Gained on Use of Eco-friendly Botanicals to Extend the Shelf Life of Food Grain Flour.

The Table 5 brings out the knowledge gained on the storage methods using botanicals among the selected rural households. The respondents were trained on method of use of botanicals in storage and preservation of grain flours to increase the shelf life. Pre and post knowledge gain was tabulated and presented.

Table 5: Knowledge gained on Use of Eco-Friendly Botanicals to Extend the Shelf Life of Food Grain Flour

Botanicals	Before Training (%) (n=100)	After Training (%) (n 100)
Bay leaf	51	100
Cloves	36	100
Custard apple seeds	38	100
Garlic skin	29	100
Neem leaf	87	100
Nochi	56	100
Pongamia	49	100

Botanicals	Before Training (%) (n=100)	After Training (%) (n 100)
Red chilli	82	100
Red soil	89	100
Tulsi	64	100
Turmeric	78	100

Table 5 shows the knowledge gained on usage of botanicals to improve the shelf life of grain flours. Before training a majority (89%) of the respondents was aware of usage of red soil in preservation followed by neem leaf (87%), red chilli (82%), turmeric (78%), t*ulsi* (64%), *nochi* (56%), bay leaf (51%), *Pongamia* (49%), custard apple seeds (38%), cloves (36%) and garlic skin (29%). Post training intervention findings showed, 100 percent gain in knowledge about all the selected botanicals through training on preservation of selected grain flours. As the botanicals had a very high relevance with day-to-day life in one or other use; remembrance and recall of gained knowledge was possible by the respondents.

Impact of Intervention in Food Grains and Grain Flours Storage Period and Storage Methods followed by the Selected Rural Households Before and After Training

Table 6 shows the impact of training in food grains and grain flour storage period and storage methods followed by the selected rural households before and after training. The results of paired T-test of the variables taken such as practices of storage period of food grain, grain flours, storage method of good grain and grain flours showed significant shift in the scores obtained from before to after training at 1% significant level.This indicates that the training had a noticeable impact on the storage practices for these specific types of flour and duration categories.

Table 6: Impact of intervention in food grains and grain flours storage period and storage methods followed by the selected rural households

Areas of impact assessment	Mean scores		SD	t value
	Before training	After training		
Storage period of food grains	15.44	26	0.883	0.000*
Storage period of grain flours	4.16	8.15	0.368	0.000*
Storage method of food grains	16.80	52	5.9	0.000*
Storage method of grain flours	4.24	8.33	4.09	0.000*

** Significant at 1% level*

Socio Economic Factors Associated with Training Impact

The association between socio economic factors and training impact was assessed and the findings are presented in Table 7.

Table 7: Association between Socio Economic Factors and Training Impact

Socio Economic Variable	ANOVA values of areas of training impact			
	Grain storage period	Grain storage method	Grain flour storge period	Grain flour storage method
Education	0.000*	0.000*	0.146	0.685
Age	0.000*	0.000*	0.717	0.717
Income	0.000*	0.000*	0.000*	0.000*
Type of family	0.000*	0.000*	0.000*	0.000*
Amount spent on purchase of raw materials for food	0.000*	0.000*	0.000*	0.000*

** Significant at 1% level*

Table 7 explains the association between socio economic factors and training impact to identify the socio economic factors which influenced adoption through training impact. Variables such as income, type of family and amount spent on purchase of raw materials for food were having association with training impact on all the aspects such as grain storage period, grain storage method, grain flour storage period and grain flour storage method, as the selected rural households economical, family and diet budget influences the attitude to adopt the grain and grain flour preservation and storage technology for the benefit of their families. Education and age showed significant association in terms of grain storage period and storage method of grain. Because higher the education, better the rate of adoption due to better understanding about the importance of change.

Hence it could be assumed that family commitment of rural households influences the adoption rate. If a technology is considered as beneficial for the welfare of family, women are likely to adopt.

CONCLUSION

The study reflects the outcome of a training programme aimed at promoting eco-friendly storage methods for food grain flour among rural households in Salem district. The impact of the training programme was evident in several key aspects such as improvement in storage practices. The positive impact on botanical adoption, container choices and overall participant satisfaction underscores the importance of such initiatives in promoting sustainability and responsible practices. This study offers valuable insights for future efforts to encourage eco-conscious behaviors in food grain flour storage among rural communities. It is also suggested that according to Sustainable Development Goals (SDGs), among the 17 proposed areas, the 12th goal is on 'Responsible consumption and production' and hence every state department of agriculture, district KVKs, rural development departments and other line departments should take appropriate steps to improve storage practices of food grains and flours using eco-friendly methods among consumers in their respective areas.

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