

## **Recommendation**

**Title of the research project: Studies on quality of thermally processed Oyster Mushroom during storage (15.5.3.5)**

**Name of the department:** Dept. of Post Harvest Technology, ACH, NAU, Navsari.

### **Investigators:**

**PI:** Dr. Harish Suthar, Asst. Prof., PHT, ACH, NAU

**Co-PI:** Dr. Dev Raj, Head & Prof., PHT, ACH, NAU

**Associate:** Dr. A. K. Senapati, Asst. Prof., PHT, ACH, NAU

### **Background and justification:**

Mushrooms are the fleshy, spore-bearing fruiting body of a fungus. The economic importance of mushroom lies primarily in their use as food for human consumption. The exotic flavor, taste and fleshiness of mushroom have made it an important delicacy in human diet. Mushroom is considered to be a complete, healthy food and suitable for all age groups. Mushrooms are nutritionally rich contain proteins, dietary fiber, vitamins, minerals, etc.

Oyster mushroom (*Pleurotus ostreatus*) is the popular mushroom variety grown in Gujarat. This particular mushroom is highly perishable in nature and has limited shelf life. Hence, it requires protection from spoilage during their preparation, storage and distribution. Canning is one of the oldest methods of preserving food in which the food contents are processed and sealed in an airtight container. It is reported to extent the shelf life of the product for several months. Retorting is a method in which food is filled into a container or pouch, sealed and then heated to extremely high temperature for specific time to make the product commercially sterile. At present processed Oyster mushroom are not available in the market. So, proposed study is going to be undertaken with the following objectives:

### **Objectives:**

1. To find out the suitable packaging material and retorting condition for extending shelf life of packaged Oyster mushroom
2. To evaluate the quality parameters of processed Oyster mushroom during storage

**Name of Research Scheme and B. H.:** Centre of Excellence on PHT (B. H. 12935)

**Year of Commencement:** 2020-2021

## Technical programme:

**Crop and Variety: Oyster mushroom - *Pleurotus ostreatus***

## Experimental Details:

**FCRD:** Completely Randomized Design with Factorial concept

**Repetitions:** 3

**Treatment combinations:** 6

**Factor 1:** Packaging material (P) levels = 2

1. Glass bottle (500 g) (P<sub>1</sub>)
2. Tin Can - A2 ½ (850 g) (P<sub>2</sub>)

**Factor 2:** Retorting time (R) levels = 3

1. 25 min (R<sub>1</sub>)
2. 35 min (R<sub>2</sub>)
3. 45 min (R<sub>3</sub>)

## Treatment Combinations:

P <sub>1</sub> R <sub>1</sub>	P <sub>2</sub> R <sub>1</sub>
P <sub>1</sub> R <sub>2</sub>	P <sub>2</sub> R <sub>2</sub>
P <sub>1</sub> R <sub>3</sub>	P <sub>2</sub> R <sub>3</sub>

18 bottles/tins (9 glass bottles + 9 tin cans) used per repetition per treatment

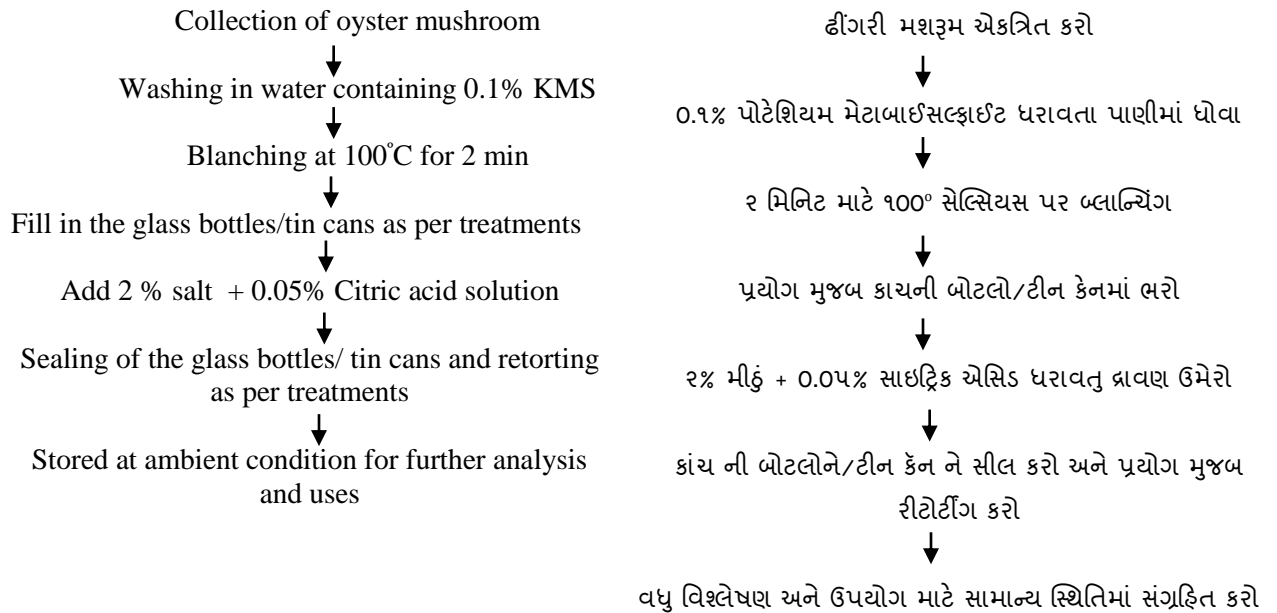
**Sample size:** 200 g of oyster mushroom filled in glass bottle and 400 g of oyster mushroom was filled in A2 ½ tin can.

**Storage period:** 0, 3 and 6 months

## Observations recorded:

<u>Physico-chemical parameters</u>	<u>Sensory parameters</u> (9-point hedonic scale)	<u>Microbiological parameters:</u> (CFU g <sup>-1</sup> )
Total Soluble Solids (%) Acidity (%) Protein (%) Reducing sugar (%) Total sugars (%) Ascorbic acid (mg 100g <sup>-1</sup> )	Color Taste Flavor Texture Overall acceptability	Aerobic plate count Coliform count Yeast and Mould count

## Process Flow Chart/પ્રક્રિયાના પગલાં અને તેમનો ક્રમ:



## Results:

The experiment was carried out to study the quality of thermally processed Oyster mushroom during storage. The oyster mushroom was thermally processed and packed in glass bottles and Tin can (A2.5). Further, packed containers were retorted for 25, 35 and 45 min and stored at room temperature. The effect of the processing, on the physico-chemical, microbiological and sensory parameters of oyster mushroom during storage was analyzed in triplicate. The results presented in table 1 to 14 shows the effect of different treatments on the above mentioned parameters on thermally processed oyster mushroom during storage. Table 1 to 6 shows the effect of different treatments on the TSS, Acidity, Protein content, Total sugar content, Reducing sugar content and Ascorbic acid content of the thermally processed oyster mushroom after 0, 3 and 6 months of storage. Tables 7, 8 and 9 show the effect of different treatments on the bacterial load, coliforms count and fungal count, respectively. The sensory parameters of the thermally processed oyster mushroom are shown in Table 10 to 14.

The data obtained indicated that the effect of packaging material and retorting time on TSS is non-significant. After 6 months of storage highest amount of TSS was reported in treatment T<sub>5</sub> (P<sub>2</sub> x R<sub>2</sub> – Mushroom packed in tin can and retorted for 35 min) (Table 1). Similarly the effects of both the factors were non-significant on acidity (Table 2). Further, effect of thermal processing on protein content indicated that as compared to glass bottles the protein content in canned mushroom was significantly higher. T<sub>4</sub> (P<sub>2</sub> x R<sub>1</sub>) was reported to have highest (1.59 %) protein content followed by T<sub>5</sub> (P<sub>2</sub> x R<sub>2</sub> -1.52 %) (Table 3). In case of total sugar also the effect of packaging material found significant (Table 4). The amount of total sugar was higher in canned mushroom as compared to the bottled mushroom. In case of reducing sugar the effect of treatments found non-significant (Table 5). The effect of packaging material and interactive effect of both factors was reported to have non-significant effect on vitamin C content of thermally processed oyster mushroom. But effect of retorting time was significant. Highest vitamin C value was reported in T<sub>4</sub> (P<sub>2</sub> x R<sub>1</sub> - 4.00 mg 100 g<sup>-1</sup>) (Table 6). Microbiological analysis indicated that upto three months both glass and tin can remain safe but at 6 months storage oyster mushroom packaged in glass bottles reported to be positive for bacterial load. Pooled analysis indicated that at 6 months storage, treatments T<sub>1</sub> (P<sub>1</sub> x R<sub>1</sub>), T<sub>2</sub> (P<sub>1</sub> x R<sub>2</sub>) and T<sub>3</sub> (P<sub>1</sub> x R<sub>3</sub>) were reported to have  $1.82 \times 10^2$ ,  $3.46 \times 10^2$  and  $2.22 \times 10^3$ , respectively (Table 7). Further, T<sub>4</sub>, T<sub>5</sub> and T<sub>6</sub> were reported to have no bacterial load (Table 7). Coliforms as well as yeast and mould were not detected in any treatments even after 6 months of storage (Table 8 and 9). Further sensory evaluation of thermally processed oyster mushroom of all treatments was analyzed after 0, 3 and 6 months storage. Analysis of Color, Taste, Flavor, Texture and Overall acceptability indicated that packaging material had significant effect on the sensory quality of the oyster mushroom. Further, the effect of retorting time was found non-significant for all the sensory parameters (Table 10-14).

## Conclusion:

The analysis of thermally processed oyster mushroom of all 6 treatment combinations indicated that the effect of both the factors (Packaging material and retorting time) and their interaction was non-significant on TSS and acidity. Further, protein and total sugar content analysis after 6 month storage indicated that as compared to glass bottles the protein and total sugar content in canned mushroom was significantly higher. Effect of both the factors was found non-significant on reducing sugar content of thermally processed oyster mushrooms. The effect of packaging material and interactive effect of both factors was reported to have non-significant effect on vitamin C content of thermally processed oyster mushroom. But effect of retorting time

was significant. Highest protein, total sugar and vitamin C content was reported in T<sub>4</sub> (P<sub>2</sub> x R<sub>1</sub>). Microbiological analysis indicated that at 6 months storage oyster mushroom packaged in glass bottles were reported to be positive for bacterial load while canned mushrooms were reported as free from microbial load. Analysis of Color, Taste, Flavor, Texture and Overall acceptability indicated that packaging material had significant effect on the sensory quality of the oyster mushroom. Further, the effect of retorting time was found non-significant for all the sensory parameters. Overall study indicated that T<sub>4</sub> (P<sub>2</sub> x R<sub>1</sub>) thermally processed oyster mushroom packed in tin and retorted for 25 min can be stored for 6 months with better nutritional quality values as compared to other treatment combinations.

**Proximate analysis of oyster mushroom *Pleurotus ostreatus***

Sr. No.	Parameters	Composition
1.	TSS (°B)	2.96 ± 0.16
2.	Acidity (%)	0.19 ± 0.05
3.	Protein (%)	2.85 ± 0.18
4.	Total Carbohydrate (%)	5.00 ± 0.33
5.	Vitamin C (mg100 <sup>-1</sup> gm)	8.89 ± 0.38
6.	Total Plate Count (cfu gm <sup>-1</sup> )	1.5×10 <sup>2</sup>
7.	Crude Fiber (%)	13.25 ± 0.33
8.	Ash (%)	1.47 ± 0.25
9.	Na <sup>+</sup> (mg100 <sup>-1</sup> gm)	15.36 ± 0.49
10.	K <sup>+</sup> (mg100 <sup>-1</sup> gm)	196.32 ± 0.33
11.	Moisture (%)	88.68 ± 0.49

**Table 1: The effect of different treatment combinations on the TSS (°Brix) of the packaged oyster mushrooms**

1Y	0M				3 M				6 M			
	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	1.667	1.667	1.833	1.72	1.917	2.000	1.917	1.94	2.00	2.00	2.08	2.03
P <sub>2</sub>	1.833	1.833	1.833	1.83	2.000	1.917	1.917	1.94	2.00	2.17	2.00	2.06
Mean	1.75	1.75	1.83	1.78	1.96	1.96	1.92	1.94	2.00	2.08	2.04	2.04
S.Em. ±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.07	0.08	0.12		0.04	0.05	0.07		0.03	0.03	0.05	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		NS	NS	NS	
	11.48				6.06				4.08			
2Y	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	1.92	2.08	1.92	1.97	2.000	2.167	2.083	2.08	2.00	2.25	2.17	2.14
P <sub>2</sub>	2.00	2.00	2.00	2.00	2.000	2.167	2.083	2.08	2.25	2.25	2.17	2.22
Mean	1.96	2.04	1.96	1.99	2.00	2.17	2.08	2.08	2.13	2.25	2.17	2.18
S.Em. ±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.034	0.042	0.059		0.04	0.05	0.07		0.03	0.03	0.05	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		NS	NS	0.15	
CV %	5.14				5.66				3.82			
Pooled	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	1.79	1.88	1.88	1.85	1.96	2.08	2.00	2.01	2.00	2.13	2.13	2.08
P <sub>2</sub>	1.92	1.92	1.92	1.92	2.00	2.04	2.00	2.01	2.13	2.21	2.08	2.14
Mean	1.85	1.90	1.90	1.88	1.98	2.06	2.00	2.01	2.06	2.17	2.10	2.11
S.Em. ±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.04	0.05	0.07		0.03	0.04	0.05		0.02	0.02	0.07	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		NS	NS	NS	
CV %	8.57				5.85				3.95			

**Table 2: The effect of different treatment combinations on the Acidity (%) of the packaged oyster mushrooms**

1Y	0M				3 M				6 M			
	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	0.29	0.29	0.28	0.28	0.299	0.305	0.299	0.30	0.31	0.32	0.32	0.32
P <sub>2</sub>	0.29	0.29	0.29	0.29	0.305	0.299	0.305	0.30	0.32	0.31	0.32	0.32
Mean	0.29	0.29	0.28	0.29	0.30	0.30	0.30	0.30	0.31	0.31	0.32	0.32
S.Em ±	P		R		P x R		P		R		P x R	
	0.002		0.003		0.004		0.01		0.01		0.01	
CD <sub>0.05</sub>	NS		NS		NS		NS		NS		NS	
	2.64				5.19				6.74			
2Y	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	0.26	0.26	0.25	0.25	0.267	0.278	0.267	0.27	0.29	0.30	0.32	0.30
P <sub>2</sub>	0.26	0.28	0.26	0.26	0.288	0.288	0.288	0.29	0.32	0.31	0.32	0.32
Mean	0.26	0.27	0.25	0.26	0.28	0.28	0.28	0.28	0.30	0.30	0.32	0.31
S.Em.±	P		R		P x R		P		R		P x R	
	0.006		0.007		0.010		0.01		0.01		0.01	
CD <sub>0.05</sub>	NS		NS		NS		NS		NS		0.15	
CV %	6.54				8.11				5.45			
Pooled	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	0.28	0.28	0.26	0.27	0.29	0.29	0.28	0.29	0.30	0.31	0.32	0.31
P <sub>2</sub>	0.28	0.29	0.28	0.28	0.30	0.30	0.30	0.30	0.32	0.31	0.32	0.32
Mean	0.28	0.28	0.27	0.28	0.29	0.29	0.29	0.29	0.31	0.31	0.32	0.31
S.Em.±	P		R		P x R		P		R		P x R	
	0.003		0.004		0.005		0.005		0.005		0.007	
CD <sub>0.05</sub>	NS		NS		NS		NS		NS		NS	
CV %	4.74				6.58				5.75			

**Table 3: The effect of different treatment combinations on the protein (%) of the packaged oyster mushrooms**

1Y	0M				3 M				6 M			
	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	1.68	1.56	1.56	1.60	1.58	1.55	1.49	1.54	1.34	1.32	1.39	1.35
P <sub>2</sub>	1.65	1.58	1.50	1.58	1.68	1.54	1.51	1.58	1.61	1.40	1.44	1.49
Mean	1.67	1.57	1.53	1.59	1.63	1.54	1.50	1.56	1.48	1.36	1.41	1.42
S.Em.±	P		R	P x R	P		R	P x R	P		R	P x R
	0.01		0.02	0.02	0.02		0.03	0.04	0.03		0.03	0.05
CD <sub>0.05</sub>	NS		0.05	NS	NS		0.09	NS	0.08		NS	NS
	2.68				4.51				5.61			
2Y	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	1.74	1.51	1.59	1.61	1.61	1.43	1.45	1.50	1.47	1.39	1.38	1.41
P <sub>2</sub>	1.70	1.76	1.55	1.67	1.61	1.69	1.50	1.60	1.57	1.64	1.45	1.55
Mean	1.72	1.63	1.57	1.64	1.61	1.56	1.47	1.55	1.52	1.51	1.41	1.48
S.Em.±	P		R	P x R	P		R	P x R	P		R	P x R
	0.02		0.03	0.04	0.02		0.02	0.03	0.02		0.02	0.03
CD <sub>0.05</sub>	NS		0.08	0.11	0.06		0.07	0.10	0.06		0.07	0.10
CV %	3.90				3.54				3.71			
Pooled	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	1.72	1.53	1.57	1.61	1.59	1.49	1.47	1.52	1.41	1.35	1.38	1.38
P <sub>2</sub>	1.68	1.67	1.53	1.63	1.65	1.62	1.50	1.59	1.59	1.52	1.45	1.52
Mean	1.70	1.60	1.55	1.62	1.62	1.55	1.49	1.55	1.50	1.44	1.42	1.45
S.Em.±	P		R	P x R	P		R	P x R	P		R	P x R
	0.03		0.02	0.05	0.02		0.02	0.07	0.02		0.04	0.06
CD <sub>0.05</sub>	NS		0.04	0.05	0.05		0.05	0.11	0.05		NS	NS
CV %	3.39				4.14				4.76			

**Table 4: The effect of different treatment combinations on the total sugar (%) of the packaged oyster mushrooms**

1Y	0M				3 M				6 M			
	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	2.77	2.70	2.66	2.71	2.84	2.85	2.94	2.88	2.90	2.98	2.93	2.94
P <sub>2</sub>	2.84	2.81	2.79	2.81	2.95	2.83	2.97	2.91	3.05	2.99	3.01	3.02
Mean	2.80	2.75	2.73	2.76	2.89	2.84	2.96	2.90	2.98	2.99	2.97	2.98
S.Em.±	P		R	P x R	P		R	P x R	P		R	P x R
	0.03		0.03	0.04	0.02		0.02	0.03	0.02		0.03	0.04
CD <sub>0.05</sub>	0.08		NS	NS	NS		0.07	NS	0.07		NS	NS
	<b>2.73</b>				1.95				2.27			
2Y	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	2.48	2.47	2.41	2.46	2.64	2.67	2.75	2.69	2.78	2.80	2.86	2.81
P <sub>2</sub>	2.54	2.52	2.52	2.53	2.97	2.65	2.75	2.79	3.16	2.74	2.89	2.93
Mean	2.51	2.50	2.47	2.49	2.80	2.66	2.75	2.74	2.97	2.77	2.87	2.87
S.Em.±	P		R	P x R	P		R	P x R	P		R	P x R
	0.02		0.03	0.04	0.02		0.02	0.03	0.02		0.02	0.03
CD <sub>0.05</sub>	0.07		NS	NS	0.06		0.07	0.11	0.06		0.07	0.10
CV %	2.79				2.18				1.90			
Pooled	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	2.62	2.59	2.54	2.58	2.74	2.76	2.85	2.78	2.84	2.89	2.89	2.87
P <sub>2</sub>	2.69	2.66	2.66	2.67	2.96	2.74	2.86	2.85	3.11	2.87	2.95	2.97
Mean	2.66	2.62	2.60	2.63	2.85	2.75	2.86	2.82	2.97	2.88	2.92	2.92
S.Em.±	P		R	P x R	P		R	P x R	P		R	P x R
	0.02		0.02	0.03	0.01		0.03	0.05	0.02		0.05	0.06
CD <sub>0.05</sub>	0.04		NS	NS	0.04		NS	NS	0.04		NS	NS
CV %	2.77				2.07				2.11			



**Table 5: The effect of different treatment combinations on the reducing sugar (%) of the packaged oyster mushrooms**

1Y	0M				3 M				6 M			
	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	0.019	0.019	0.020	0.019	0.019	0.020	0.021	0.020	0.016	0.016	0.014	0.016
P <sub>2</sub>	0.019	0.021	0.019	0.020	0.020	0.020	0.018	0.020	0.020	0.018	0.018	0.018
Mean	0.019	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.018	0.017	0.016	0.017
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.0003	0.0004	0.0005		0.0003	0.0003	0.0005		0.0003	0.0004	0.0005	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	0.001		0.0009	0.001	NS	
	<b>4.67</b>				4.12				5.39			
2Y	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	0.017	0.018	0.018	0.018	0.016	0.016	0.017	0.017	0.015	0.015	0.016	0.015
P <sub>2</sub>	0.018	0.019	0.018	0.018	0.016	0.018	0.019	0.017	0.015	0.016	0.017	0.016
Mean	0.018	0.018	0.018	0.018	0.016	0.017	0.018	0.017	0.015	0.016	0.016	0.016
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.0002	0.0003	0.0004		0.0002	0.0002	0.0003		0.0002	0.0002	0.0003	
CD <sub>0.05</sub>	NS	NS	NS		0.0005	0.0007	NS		0.0005	0.0007	NS	
CV %	4.14				3.09				3.09			
Pooled	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	0.018	0.018	0.019	0.019	0.018	0.019	0.019	0.018	0.016	0.017	0.016	0.017
P <sub>2</sub>	0.019	0.020	0.019	0.019	0.018	0.019	0.018	0.018	0.018	0.018	0.018	0.017
Mean	0.019	0.019	0.019	0.019	0.018	0.019	0.019	0.018	0.017	0.017	0.017	0.017
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.0002	0.0002	0.0003		0.0005	0.0002	0.0008		0.0006	0.0008	0.0006	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		NS	NS	NS	
CV %	4.44				3.73				4.38			

**Table 6: The effect of different treatment combinations on the vitamin C (mg 100g<sup>-1</sup>) of the packaged oyster mushrooms**

1Y	0M				3 M				6 M			
	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	4.13	3.84	3.84	3.94	3.93	3.64	3.63	3.73	3.51	3.44	3.43	3.46
P <sub>2</sub>	4.16	3.95	3.87	3.99	3.95	3.74	3.67	3.79	3.74	3.53	3.46	3.58
Mean	4.15	3.90	3.85	3.97	3.94	3.69	3.65	3.76	3.63	3.49	3.45	3.52
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.12	0.15	0.21		0.07	0.08	0.12		0.11	0.13	0.19	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		NS	NS	NS	
	8.98				5.54				9.16			
2Y	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	4.26	4.26	4.06	4.20	4.26	4.06	3.83	4.05	4.06	3.84	3.62	3.84
P <sub>2</sub>	4.48	4.27	4.25	4.33	4.26	4.05	4.06	4.12	4.25	3.84	3.63	3.91
Mean	4.37	4.26	4.16	4.26	4.26	4.05	3.95	4.09	4.16	3.84	3.63	3.87
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.11	0.14	0.19		0.11	0.14	0.19		0.10	0.12	0.17	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		NS	0.38	NS	
CV %	7.91				8.26				7.78			
Pooled	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	4.20	4.06	3.95	4.07	4.09	3.85	3.73	3.89	3.79	3.64	3.53	3.65
P <sub>2</sub>	4.32	4.11	4.07	4.16	4.10	3.89	3.86	3.95	4.00	3.69	3.55	3.74
Mean	4.26	4.08	4.01	4.12	4.10	3.87	3.80	3.87	3.89	3.66	3.54	3.70
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.08	0.10	0.14		0.06	0.08	0.11		0.07	0.09	0.12	
CD <sub>0.05</sub>	NS	NS	NS		NS	0.22	NS		NS	0.26	NS	
CV %	8.43				7.15				8.45			



**Table 10: The effect of different treatment combinations on the color of the packaged oyster mushrooms (9 point hedonic scale)\***

1Y	0M				3 M				6 M			
	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	7.83	7.17	7.50	7.50	8.00	8.20	7.80	8.00	6.20	6.80	6.60	6.53
P <sub>2</sub>	7.67	7.67	7.50	7.61	7.60	8.20	7.80	7.87	7.00	7.60	7.40	7.33
Mean	7.75	7.42	7.50	7.56	7.80	8.20	7.80	7.93	6.60	7.20	7.00	6.93
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.13	0.16	0.23		0.28	0.34	0.50		0.16	0.20	0.28	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		0.47	NS	NS	
CV%	7.38				13.71				8.93			
2Y	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	8.00	7.67	7.67	7.78	8.20	7.80	7.60	7.87	6.00	6.40	6.40	6.27
P <sub>2</sub>	7.83	7.67	7.67	7.72	8.00	7.80	8.00	7.93	7.40	7.20	7.00	7.20
Mean	7.91	7.67	7.67	7.75	8.10	7.80	7.80	7.90	6.70	6.80	6.70	6.73
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.22	0.27	0.38		0.22	0.27	0.38		0.17	0.21	0.29	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		0.50	NS	NS	
CV %	12.05				10.84				9.78			
Pooled	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	<b>7.92</b>	7.42	7.58	7.64	8.10	8.00	7.70	7.93	6.10	6.60	6.50	6.40
P <sub>2</sub>	7.75	7.67	7.58	7.67	7.80	8.00	7.90	7.90	7.20	7.40	7.20	7.27
Mean	7.83	7.54	7.58	7.65	7.95	8.00	7.80	7.92	6.65	7.00	6.85	6.83
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.13	0.16	0.22		1.78	0.22	0.30		0.12	0.14	0.20	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		0.33	NS	NS	
CV %	10.05				12.37				9.35			

**Table 11: The effect of different treatment combinations on the taste of the packaged oyster mushrooms (9 point hedonic scale)\***

1Y	0M				3 M				6 M			
	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	7.50	7.50	7.67	7.56	8.00	8.00	7.80	7.93	-	-	-	-
P <sub>2</sub>	8.17	7.83	7.67	7.89	8.20	8.00	8.20	8.13	7.40	7.60	7.40	7.47
Mean	7.83	7.67	7.67	7.72	8.10	8.00	8.00	8.03	-	-	-	-
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.16	0.19	0.27		0.33	0.40	0.57		-	-	-	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		-	-	-	
CV%	8.63				15.75				10.71			
2Y	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	7.67	7.67	7.50	7.61	7.80	8.00	7.60	7.80	-	-	-	-
P <sub>2</sub>	8.00	7.83	7.83	7.89	8.20	8.20	7.80	8.07	7.20	7.40	7.00	7.20
Mean	7.83	7.75	7.67	7.75	8.00	8.10	7.70	7.93	-	-	-	-
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.23	0.28	0.39		0.20	0.25	0.35		-	-	-	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		-	-	-	
CV %	12.43				9.76				-			
Pooled	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	7.58	7.58	7.58	7.58	7.90	8.00	7.70	7.87	-	-	-	-
P <sub>2</sub>	8.08	7.83	7.75	7.89	8.20	8.10	8.00	8.10	7.30	7.50	7.20	7.33
Mean	7.83	7.71	7.67	7.74	8.05	8.05	7.85	7.98	-	-	-	-
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.14	0.17	0.24		0.19	0.23	0.33		-	-	-	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		-	-	-	
CV %	10.71				13.14				-			

**Table 12: The effect of different treatment combinations on the flavor of the packaged oyster mushrooms (9 point hedonic scale)\***

1Y	0M				3 M				6 M			
	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	7.83	7.83	7.83	7.83	8.00	8.00	8.20	8.07	5.40	5.80	5.20	5.47
P <sub>2</sub>	8.00	7.83	8.00	7.94	8.20	8.00	8.00	8.07	7.00	7.20	7.00	7.07
Mean	7.91	7.83	7.92	7.89	8.10	8.00	8.10	8.07	6.20	6.50	6.10	6.27
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.19	0.23	0.33		0.32	0.40	0.56		0.25	0.30	0.42	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		NS	NS	NS	
CV%	10.18				15.52				15.14			
2Y	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	7.83	7.67	7.67	7.73	7.80	8.00	7.80	7.87	4.80	5.00	4.60	4.80
P <sub>2</sub>	7.83	8.00	7.67	7.83	8.00	8.00	7.80	7.93	7.20	7.20	6.80	7.07
Mean	7.83	7.83	7.67	7.78	7.90	8.00	7.80	7.90	6.00	6.10	5.70	5.93
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.22	0.27	0.38		0.23	0.28	0.39		0.15	0.19	0.27	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		NS	NS	NS	
CV %	11.89				11.08				9.97			
Pooled	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	7.83	7.75	7.75	7.78	7.90	8.00	8.00	7.97	5.10	5.40	4.90	5.13
P <sub>2</sub>	7.92	7.92	7.83	7.89	8.10	8.00	7.90	8.00	7.10	7.20	6.90	7.07
Mean	7.88	7.83	7.79	7.83	8.00	8.00	7.95	7.98	6.10	6.30	5.90	6.10
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.14	0.17	0.25		0.20	0.24	0.34		0.15	0.17	0.25	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		0.42	NS	NS	
CV %	11.06				13.53				12.96			

**Table 13: The effect of different treatment combinations on the texture of the packaged oyster mushrooms (9 point hedonic scale)\***

1Y	0M				3 M				6 M			
	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	8.17	8.00	7.83	8.00	8.20	7.80	7.60	7.87	5.80	5.60	5.20	5.53
P <sub>2</sub>	8.33	8.17	8.00	8.17	8.20	7.80	7.60	7.87	7.20	7.60	7.20	7.33
Mean	8.25	8.08	7.92	8.08	8.20	7.80	7.60	7.87	6.50	6.60	6.20	6.43
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.17	0.21	0.30		0.27	0.33	0.46		0.22	0.27	0.38	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		0.65	NS	NS	
CV%	8.99				13.13				13.31			
2Y	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	8.33	8.17	7.67	8.05	7.80	8.00	7.60	7.80	5.40	5.20	5.00	5.20
P <sub>2</sub>	8.17	8.00	7.83	8.00	7.80	8.00	7.80	7.87	7.00	7.40	6.80	7.07
Mean	8.25	8.08	7.75	8.03	7.80	8.00	7.70	7.83	6.20	6.30	5.90	6.13
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.18	0.22	0.31		0.21	0.26	0.36		0.17	0.20	0.29	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		0.49	NS	NS	
CV %	9.42				10.29				10.52			
Pooled	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	8.25	8.03	7.75	8.03	8.00	7.90	7.60	7.83	5.60	5.40	5.10	5.37
P <sub>2</sub>	8.25	8.08	7.92	8.08	8.00	7.90	7.70	7.87	7.10	7.50	7.00	7.20
Mean	8.25	8.08	7.83	8.06	8.00	7.90	7.65	7.85	6.35	6.45	6.05	6.28
S.Em.±	P	R	P x R		P	R	P x R		P	R	P x R	
	0.12	0.15	0.21		0.17	0.21	0.29		0.14	0.17	0.24	
CD <sub>0.05</sub>	NS	NS	NS		NS	NS	NS		0.39	NS	NS	
CV %	9.21				11.80				12.07			

**Table 14: The effect of different treatment combinations on the overall acceptability of the packaged oyster mushrooms (9 point hedonic scale)\***

1Y	0M				3 M				6 M			
	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	7.83	7.67	7.83	7.78	8.20	8.00	8.00	8.07	-	-	-	-
P <sub>2</sub>	8.17	8.17	8.00	8.11	8.20	8.00	8.00	8.07	7.10	7.55	7.30	7.32
Mean	8.42	7.92	7.92	7.94	8.20	8.00	8.00	8.07	-	-	-	-
S.Em.±	P		R	P x R	P		R	P x R	P		R	P x R
	0.13		0.16	0.22	0.31		0.37	0.53	-		-	-
CD <sub>0.05</sub>	NS		NS	NS	NS		NS	NS	-		-	-
CV%	6.77				14.67				-			
2Y	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	9.00	7.17	7.83	8.00	8.20	8.00	7.80	8.00	-	-	-	-
P <sub>2</sub>	7.67	8.17	8.17	8.00	8.20	8.40	8.20	8.27	7.20	7.40	7.00	7.20
Mean	8.33	7.67	8.00	8.00	8.20	8.20	8.00	8.13	-	-	-	-
S.Em.±	P		R	P x R	P		R	P x R	P		R	P x R
	0.11		0.14	0.19	0.15		0.19	0.27	-		-	-
CD <sub>0.05</sub>	NS		NS	NS	NS		NS	NS	-		-	-
CV %	5.89				7.27				-			
Pooled	R1	R2	R3	Mean	R1	R2	R3	Mean	R1	R2	R3	Mean
P <sub>1</sub>	8.41	7.42	7.83	7.89	8.20	8.00	7.90	8.03	-	-	-	-
P <sub>2</sub>	7.92	8.17	8.08	8.06	8.20	8.20	8.10	8.17	7.15	7.48	7.15	7.26
Mean	8.17	7.79	7.96	7.97	8.20	8.10	8.00	8.10	-	-	-	-
S.Em.±	P		R	P x R	P		R	P x R	P		R	P x R
	0.09		0.10	0.41	0.17		0.21	0.29	-		-	-
CD <sub>0.05</sub>	NS		NS	NS	NS		NS	NS	-		-	-
CV %	6.34				11.55				-			



**Table 15: Costing for oyster mushroom bottling and canning**

TREATMENT	COST OF 100 kg MUSHROOM (Rs.)	CONTAINER COST (Rs.)	RAW MATERIAL COST (Rs.)	TOTAL MATERIAL COST (Rs.)	RETORTING (Rs.)	Processing charge for bottle (Rs. 7) and can (Rs. 10)	PRODUCTION COST For 100 bottles and 50 tin (Rs.)	Per container price (Rs.)	SELLING COST (20%) (Rs.)	NET PROFIT (Rs.)
T <sub>1</sub> (P <sub>1</sub> x R <sub>1</sub> )	20000.0	1500.0	12.0	21512.0	78.0	700.0	22290.0	222.9	280.0	5710.0
T <sub>2</sub> (P <sub>1</sub> x R <sub>2</sub> )	20000.0	1500.0	12.0	21512.0	110.0	700.0	22322.0	223.2	280.0	5678.0
T <sub>3</sub> (P <sub>1</sub> x R <sub>3</sub> )	20000.0	1500.0	12.0	21512.0	141.0	700.0	22353.0	223.5	280.0	5647.0
T <sub>4</sub> (P <sub>2</sub> x R <sub>1</sub> )	20000.0	1250.0	27.5	21277.5	78.0	500.0	21855.5	437.1	530.0	4644.5
T <sub>5</sub> (P <sub>2</sub> x R <sub>2</sub> )	20000.0	1250.0	27.5	21277.5	110.0	500.0	21887.5	437.8	530.0	4612.5
T <sub>6</sub> (P <sub>2</sub> x R <sub>3</sub> )	20000.0	1250.0	27.5	21277.5	141.0	500.0	21918.5	438.4	530.0	4581.5

Rs. 15 per bottle and Rs. 25 per tin (Total bottle-100 and tin 50)

Rs. 50 per kg NaCl and Rs. 400 per kg Citric acid

200g NaCl and 5g Citric acid In 100 bottles and 500 gm NaCl and 6.25 gm Citric acid in 50 Tins

Power used (Watt) – 4000, Per hour consumption (kWh) – 4, GEB unit rate (price per kWh) – Rs. 4.7

Rs. 7.83 for 25 min, 10.97 for 35 min, 14.10 for 45 min



**Figure 1: (1) Washed oyster mushroom, (2) Blanching (3) Water drain from blanched oyster mushroom (4) Weighing (5) Oyster mushroom bottles (6) filling in containers (7) Seaming (8) Retorting (9) Cooling.**

### **Recommendation**

Processors and entrepreneurs are recommended to preserve the oyster mushroom in A2 ½ SR tin can (99 x 119 mm, 850 g capacity) by following steps: washing of mushroom in water containing 0.1% KMS, blanching, filling of 400 g mushroom, addition of solution containing 2.00 % NaCl and 0.05 % citric acid in tin can, exhausting, seaming, retorting at 121°C and 15 psi pressure for 25 min followed by cooling. The canned oyster mushroom can be stored and utilized up to 6 months with good quality.

### **ભલામણ**

પ્રોસેસર્સ અને ઉદ્યોગસાહસિકોને ભલામણ કરવામાં આવે છે કે ઢીંગરી મુશરૂમ ને એર ૧/૨ એસ. આર. ટીન કેન (૯૯ × ૧૧૯ એમ. એમ., ૮૫૦ ગ્રા. શ્રમતા) માં સાચવવા માટે તેઓ નીચે દર્શાવેલા પગલાંને અનુસરે: મુશરૂમ ને ૦.૧% પોટેશિયમ મેટાબાઈસલ્ફાઈટ ધરાવતા પાણીમાં ધોવા, બ્લાન્ચિંગ, ૪૦૦ ગ્રા. મુશરૂમ ને ભરવા, ૨.૦૦ % સોડિયમ ક્લોરાઇડ અને ૦.૦૫ % સાઈટ્રિક એસીડ ધરાવતાં દ્રાવણ ને ઉમેરવું, એક્ઝોસ્ટિંગ, સીમિંગ, ૧૨૧ ડિગ્રી સેલ્સિયસ તાપમાને અને ૧૫ પી.એસ.આઈ. દબાણે, ૨૫ મિનીટ રિટોર્ટિંગ કર્યા બાદ ઠંડુ કરવું. તૈયાર કરેલ કેન્ડ ઢીંગરી મુશરૂમ સારી ગુણવત્તા સાથે ૬ મહિના સુધી સંગ્રહિત અને તેનો ઉપયોગ કરી શકાય છે.