



Effect of Pre-treatment on Physical Characteristics of Varieties of Oyster Mushroom using Different Drying Methods by Comparative Evaluation

Chinmay Anil Chorage* Shanker Suwan Singh**

* Ph.D Scholar, Processing and Food Engineering Department, VIAET, SHUATS, Prayagraj (UP)- India.

** Assistant Professor, Dairy Engineering, SHUATS, Prayagraj(UP)- India.
shanranu80@gmail.com

ABSTRACT

Drying has a great significance in preservation of agricultural goods. Several drying techniques are implemented for drying of agricultural goods. This study was carried out to identify best drying method with pre-treatment's for varieties of oyster mushrooms to evaluate the impact of pre-treatment and drying technique on physical characteristics of oyster mushrooms. The values content of oyster mushrooms was raised, according to a physical analysis. Mushroom powder was dried and made in powder form by two drying methods (tray drying and vacuum drying) with three different temperatures (60, 70 and 80°C). Three pre-treatment were given before drying (Untreated, Vinegar and Lemon juice). The findings obtained and statistical data revealed that vacuum dried mushroom with vinegar treated showed good quality characteristics and was found best.

Keywords: Mushroom powder, Vacuum, Pretreatment, drying method, Lemon Juice, Vinegar.

INTRODUCTION

Mushrooms that can be eaten are significant dietary sources. Because they are easily digestible, they make particularly nourishing meals for people who have disabilities. They are consumed for both their significant nutritional benefits and their natural flavour and taste. According to Aremu et al. (2009), mushrooms have a higher protein content than all other fruits and vegetables on a fresh weight basis, but they fall short of the traditional protein sources of meat and dairy. Nonetheless, on a dry-weight basis, mushrooms are superior to dried peas and beans and comparable to dried yeast (Singh 2017).

Due to their high protein content, essential amino acid composition, high fibre content, and low fat content, mushrooms offer a high nutritional value. Moreover, edible mushrooms

contain significant amounts of the vitamins B1, B2, B12, C, D, and E for biological function. **(Heleno et al., 2010)**. Unsaturated fatty acids, phenolic compounds, tocopherols, ascorbic acid, and carotenoids are just a few of the numerous nutraceuticals that may be found in edible mushrooms. As a result, they could be consumed directly to boost health and benefit from the additive and synergistic benefits of all the bioactive substances present **(Pereira et al., 2012)**.

One of by far nutrient-dense and cholesterol-free foods is the mushroom. Oyster mushrooms have a protein content of 19 to 35%, which is made up of nine amino acids; a fat content of 1,7 to 2,2%, 72% of which include minerals (K, P, Na, Ca, Mg, Zn, Fe, Mn, Co, and Pb), unsaturated fatty acids, carbohydrates, vitamins B (thiamin, riboflavin, and niacin), vitamin D, and vitamin C, as well as very low quantities of metal microelements (Kusuma et al., 2019).

Due to their affordable price and straightforward design, the majority of tray dryers popular for a variety of drying procedures. Poor airflow distribution frequently results in variations in the dried product's final moisture content at various tray placements. In general, the temperature and velocity of the drying air have a significant impact on drying rate. Computing fluid dynamics (CFD) simulation is frequently used in drying analysis to anticipate temperature, velocity, and pressure profiles in the drying chamber because it is capable of resolving complex differential equations involving the conservation of mass, momentum, and energy using advanced numerical techniques **(Misha et al., 2013)**.

The employment of vacuum drying technology in the chemical and pharmaceutical sectors, as well as in the production of food items and biotechnology, is crucial for drying particularly heat-sensitive materials. Vacuum drying procedures can be categorised based on the physical setups utilised to add heat and remove water vapour. At low pressures, water evaporates more quickly and heat is indirectly provided through radiation or contact with a metal wall. Some materials that might discolour or disintegrate at higher temperatures can also be used at low temperatures under vacuum **(Bazyma et al., 2005)**.

METHOD AND MATERIALS

2.1 Materials

The fresh oyster mushroom varieties (White, Grey and Pink) used in this research was obtained from Biobritte mushroom farms Jaysingpur.

2.2 Methodology

Fresh oyster mushrooms were washed, cleaned, and cut into pieces with a knife before pretreatment and drying techniques were applied.

2.3 Pre-treatment for mushroom samples

Mushroom varieties were treated with different pre-treatment to see the effects on quality of powder after drying.

- **Natural**

Mushrooms were dried in tray dryer with normal method at different time and temperature combinations.

- **Vinegar**

Mushroom were kept for soaking in vinegar solution for 5, 7, 9 minutes before drying.

- **Lemon juice**

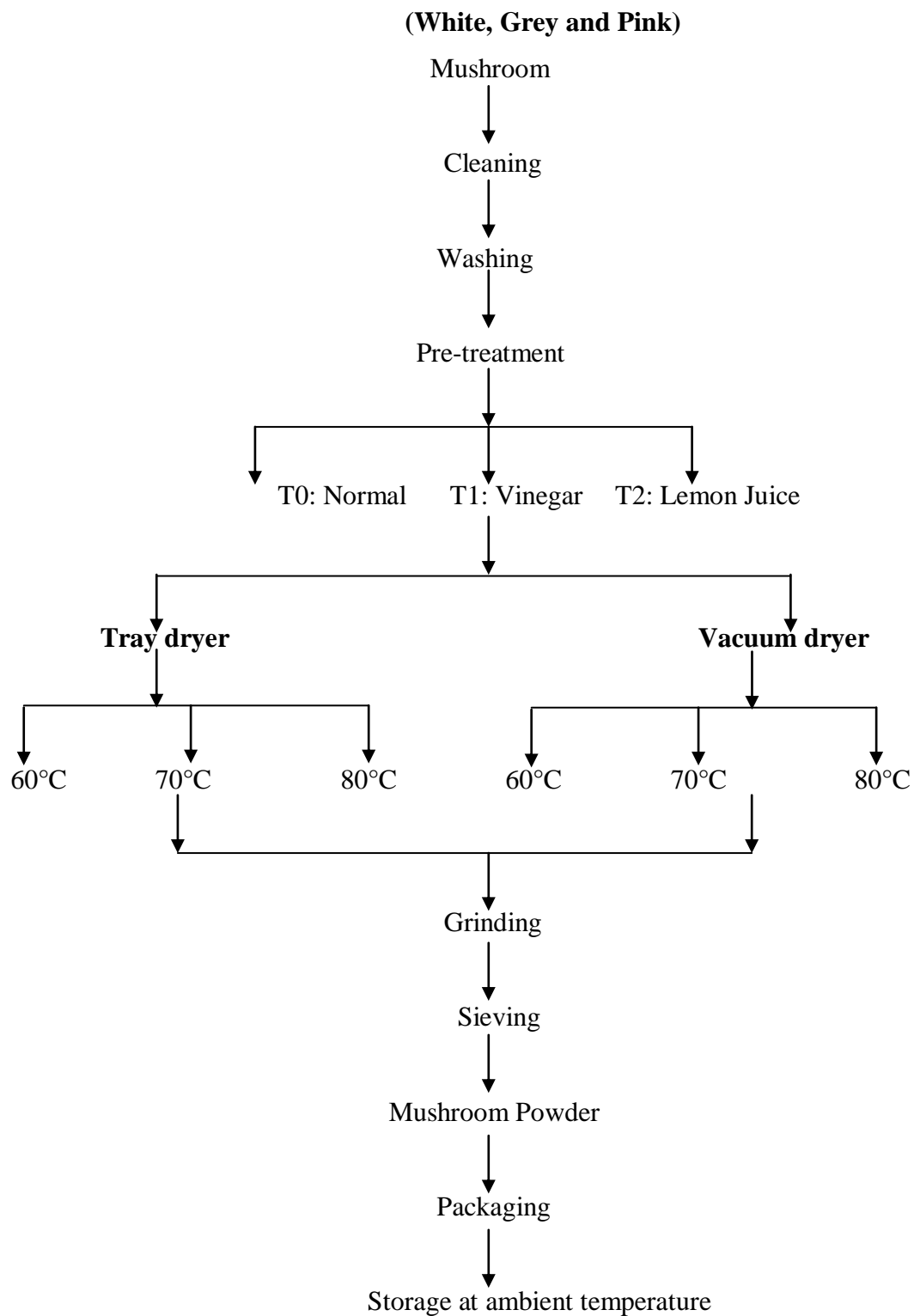
Mushroom were kept for soaking in Lemon juice for 5, 7, 9 minutes before drying.

2.4 Treatment combinations of time and temperature for mushroom drying with different dryers.

Treatment Notation	Treatments combinations	Drying methods	
T1:	(P0: Control +T1: 60 °C)	Tray dryer	Vacuum dryer
T2:	(P1: Vinegar +T1: 60 °C)		
T3:	(P2: Lemon juice+ T1: 60 °C)		
T4:	(P0: Control +T2: 70 °C)		
T5:	(P1: Vinegar +T2: 70 °C)		
T6:	(P2: Lemon juice +T2: 70 °C)		
T7:	(P0: Control+T3: 80 °C)		
T8:	(P1: Vinegar +T3: 80 °C)		
T9:	(P2: Lemon juice+T3: 80 °C)		

Table 2.1 Treatment combinations of time and temperature for mushroom drying with different dryers.

Plan of Work



2.6 Physical Properties of oyster mushroom powder

2.6.1 Yield (%)

After measuring the amount of oyster mushroom powder by applying the given formula, yield was determined.

$$\text{Yield/kg} = \frac{\text{Mass of powder}}{\text{the mass of mushrooms}} \times 100$$

2.6.2 Browning Index (OD)

According to Srivastava and Kumar, at 440 nm, optical density (OD) was used to quantify the browning index of a 5 g sample of dehydrated mushrooms (2000).

2.6.3 Water retention (ml/g)

With 20 ml of distilled water, two grammes of mushroom powder were accurately weighed and steeped for 12 hours. The soaked samples underwent a 20-minute centrifugation at 3,000 rpm. According to the procedure described by (Nollet, 2004), Following centrifugation, the amount of separated water was measured, and water retention was calculated using the formula below:

$$\text{Water retention (ml /g)} = \frac{\text{water retained (ml)}}{\text{weight of sample (g)}}$$

Where,

Water retention (ml/g) = Volume of water added (20ml) - Volume of water obtained after centrifugation

2.6.4 Swelling index

Five grammes of a dehydrated sample were soaked in 100 ml of distilled water and left at room temperature for the next day (20–30 8C). The swelling index was then determined using the formula below in accordance with the procedure described by (Nollet, 2004):

Swelling index was calculated as-

$$\text{Swelling index (ml /g)} = \frac{\text{change in volume (ml)}}{\text{amount of sample (g)}}$$

RESULTS & DISCUSSION

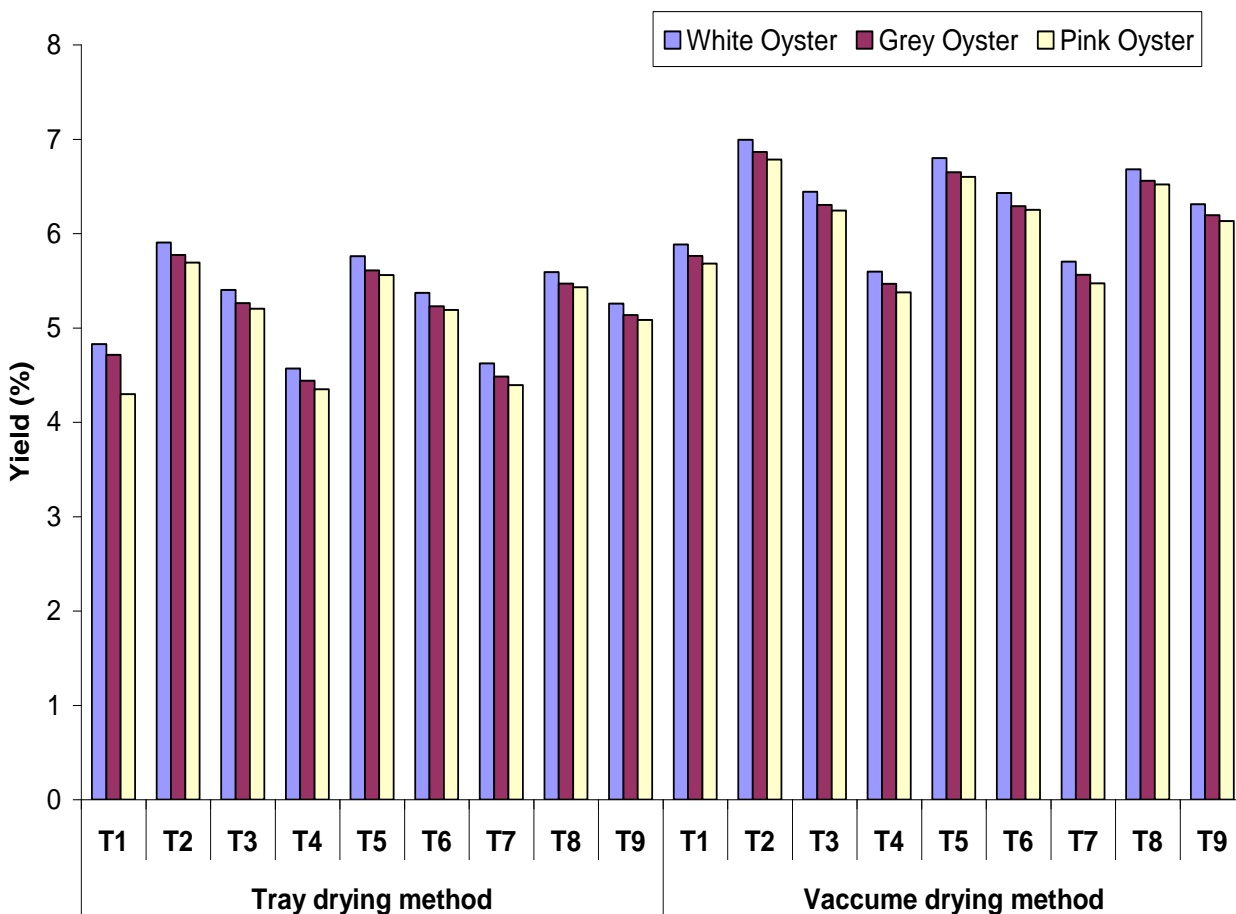
3.1 Temperature and treatment effect on Yield (%) of Oyster mushroom in Tray and Vacuum drying method

Treatments	Tray dryer			Vacuum dryer		
	White Oyster Mushroom	Grey Oyster Mushroom	Pink Oyster Mushroom	White Oyster Mushroom	Grey Oyster Mushroom	Pink Oyster Mushroom
P0: (Control)	4.673	4.546	4.347	5.728	5.598	5.511
P1: (Vinegar)	5.751	5.618	5.561	6.824	6.691	6.634
P2: (Lemon Juice)	5.343	5.210	5.159	6.394	6.262	6.209
F-Test	S	S	S	S	S	S
C.D. at 0.5%	0.115	0.171	0.127	0.068	0.076	0.081
S.Ed. (+)	0.054	0.081	0.060	0.032	0.036	0.038
Temperature						
T1: 60°C	5.378	5.250	5.064	6.440	6.310	6.237
T2: 70°C	5.233	5.093	5.033	6.276	6.136	6.076
T3: 80°C	5.157	5.030	4.969	6.231	6.106	6.042
F-Test	S	S	S	S	S	S
C.D. at 0.5%	0.115	0.171	N/A	0.068	0.076	0.081
S.Ed. (+)	0.054	0.081	0.060	0.032	0.036	0.038
Interaction (Treatment x Temperature)						
T1: (P0: Control +T1: 60 °C)	4.827	4.713	4.297	5.883	5.763	5.683
T2: (P1: Vinegar +T1: 60 °C)	5.903	5.773	5.693	6.993	6.863	6.783
T3: (P2: Lemon juice+ T1: 60 °C)	5.403	5.263	5.203	6.443	6.303	6.243
T4: (P0: Control +T2: 70 °C)	4.570	4.440	4.350	5.597	5.467	5.377
T5: (P1: Vinegar +T2: 70 °C)	5.760	5.610	5.560	6.800	6.650	6.600
T6: (P2: Lemon juice +T2: 70 °C)	5.370	5.230	5.190	6.430	6.290	6.250
T7: (P0: Control+T3: 80 °C)	4.623	4.483	4.393	5.703	5.563	5.473
T8: (P1: Vinegar +T3: 80 °C)	5.590	5.470	5.430	6.680	6.560	6.520
T9: (P2: Lemon juice+T3: 80 °C)	5.257	5.137	5.083	6.310	6.193	6.133
F-Test	NS	NS	NS	S	S	S
C.D. at 0.5%	N/A	N/A	N/A	0.118	0.132	0.141

S.Ed. (+)	0.094	0.140	0.104	0.056	0.062	0.066
-----------	-------	-------	-------	-------	-------	-------

Table 3.1 Effect of temperature and treatment on Yield (%) Oyster mushroom in Tray dryer and Vacuum dryer method

Figure 3.1 Temperature and treatment effect on Yield (%) of Oyster mushroom Tray dryer and Vacuum dryer



From the table 3.1 and fig. 3.1 it has concluded that there is minute effect of three pre-treatment viz., (Control, Vinegar and Lemon juice) and three temperature viz., (60, 70 and 80⁰C) on yield (%) of white, grey and pink oyster mushroom. The maximum yield (%) (5.903, 5.773 and 5.693) was found in treatment T2: (P1: Vinegar +T1: 60⁰C). Whereas the minimum yield

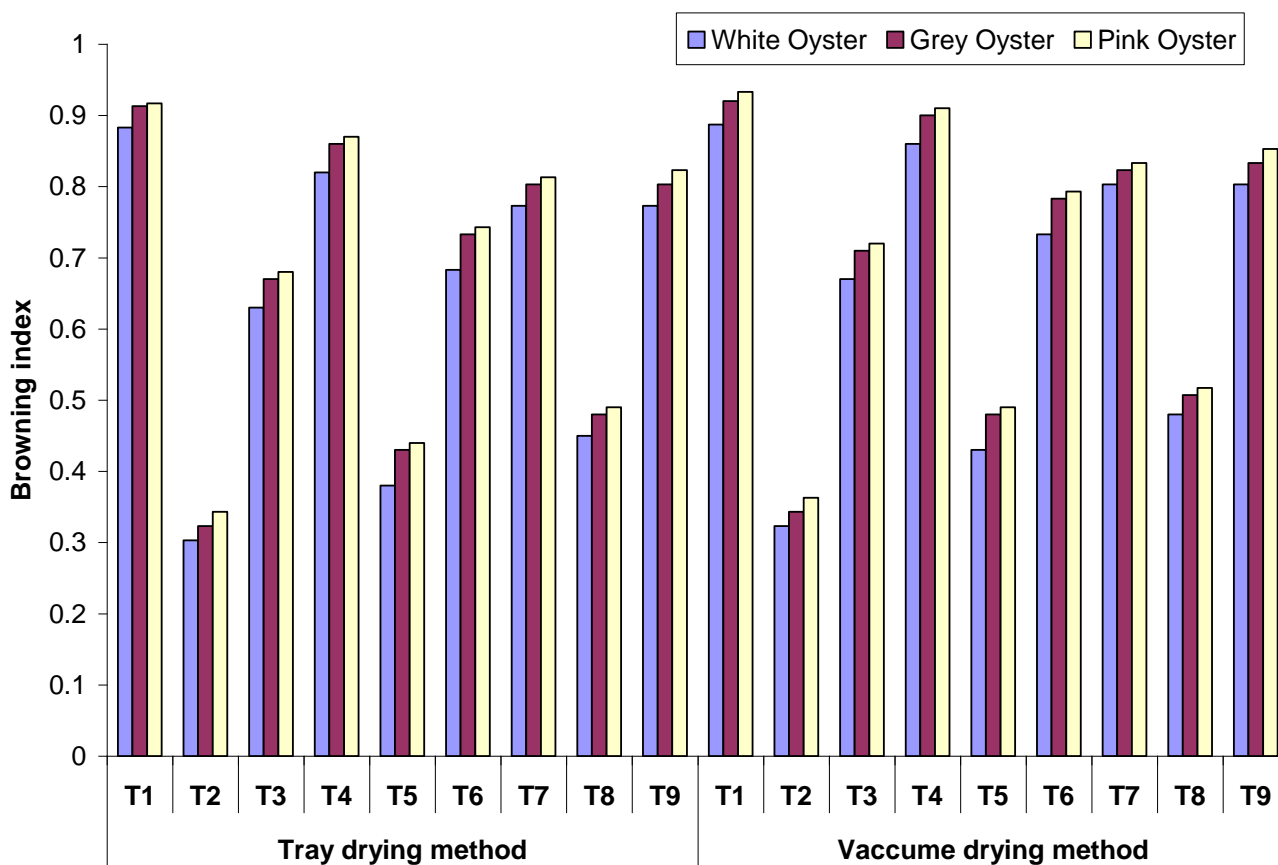
(%) (4.570 and 4.440, 4.350) was found in treatment T4: (P0: Control +T2: 70 °C) in tray drying method. The maximum yield (%) (6.993, 6.863 and 6.783) was found in treatment T2: (P1: Vinegar +T1: 60 °C). Whereas the minimum yield (%) (5.597, 5.467 and 5.377) was found in treatment T4: (P0: Control +T2: 70 °C) in vacuum drying method.

3.2 Effect of temperature and treatment on browning index of Oyster mushroom in Tray dryer and vacuum dryer method

		Tray dryer			Vacuum dryer		
Due to Pre-Treatments	Treatments	White Oyster Mushroom	Grey Oyster Mushroom	Pink Oyster Mushroom	White Oyster Mushroom	Grey Oyster Mushroom	Pink Oyster Mushroom
	P0: (Control)	0.826	0.859	0.867	0.850	0.881	0.892
	P1: (Vinegar)	0.378	0.411	0.424	0.411	0.443	0.457
	P2: (Lemon Juice)	0.696	0.736	0.749	0.736	0.776	0.789
	F-Test	S	S	S	S	S	S
	C.D. at 0.5%	0.045	0.041	0.038	0.047	0.057	0.035
	S.Ed. (+)	0.021	0.019	0.018	0.022	0.027	0.017
Due to Temperature	Temperature						
	T1:60°C	0.606	0.636	0.647	0.627	0.658	0.672
	T2: 70°C	0.628	0.674	0.684	0.674	0.721	0.731
	T3: 80°C	0.666	0.696	0.709	0.696	0.721	0.734
	F-Test	S	S	S	S	S	S
	C.D. at 0.5%	0.045	0.041	0.038	0.047	0.057	0.035
S.Ed. (+)	0.021	0.019	0.018	0.022	0.027	0.017	
Due to Int. (Pre-Treatment x Temperature)	Interaction (Treatment x Temperature)						
	T1: (P0: Control +T1: 60 °C)	0.883	0.913	0.917	0.887	0.920	0.933
	T2: (P1: Vinegar +T1: 60 °C)	0.303	0.323	0.343	0.323	0.343	0.363
	T3: (P2: Lemon juice+ T1: 60 °C)	0.630	0.670	0.680	0.670	0.710	0.720
	T4: (P0: Control +T2: 70 °C)	0.820	0.860	0.870	0.860	0.900	0.910
	T5: (P1: Vinegar +T2: 70 °C)	0.380	0.430	0.440	0.430	0.480	0.490
	T6: (P2: Lemon juice +T2: 70 °C)	0.683	0.733	0.743	0.733	0.783	0.793
	T7: (P0: Control+T3: 80 °C)	0.773	0.803	0.813	0.803	0.823	0.833
	T8: (P1: Vinegar +T3: 80 °C)	0.450	0.480	0.490	0.480	0.507	0.517
	T9: (P2: Lemon juice+T3: 80 °C)	0.773	0.803	0.823	0.803	0.833	0.853
	F-Test	S	NS	S	S	S	S
	C.D. at 0.5%	0.079	0.070	0.066	0.082	0.100	0.061
	S.Ed. (+)	0.037	0.033	0.031	0.039	0.047	0.029

Table 3.2 Temperature and treatment effect on browning index of Oyster mushroom in Tray dryer and vacuum dryer method

Figure 3.2 Temperature and treatment effect on browning index (%) of Oyster mushroom in Tray dryer and Vacuum dryer



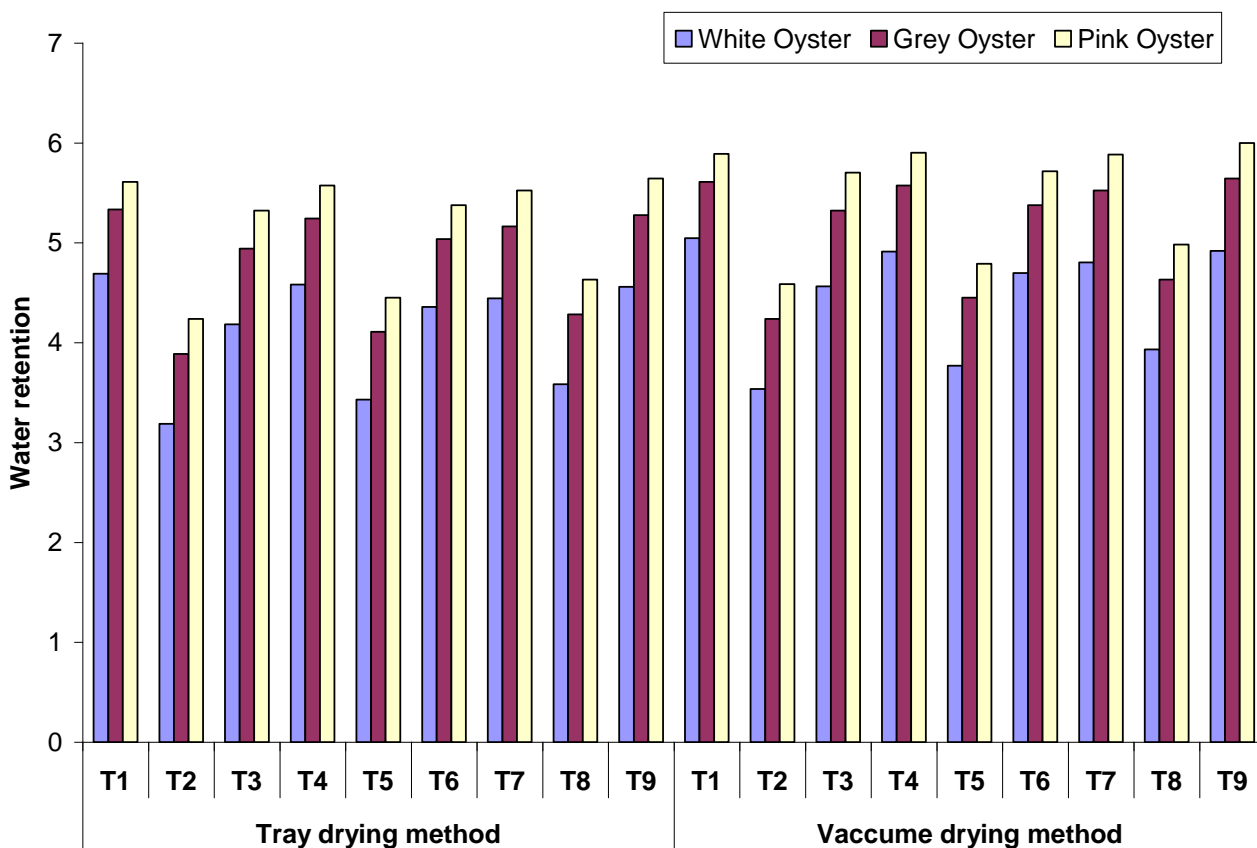
From the table 3.2 and fig. 3.2 it has concluded that there is minute effect of three pre-treatment viz., (Control, Vinegar and Lemon juice) and three temperature viz., (60, 70 and 80⁰C) on browning index of white, grey and pink oyster mushroom. The minimum browning index (0.303, 0.323, .343) was found in treatment T2: (P1: Vinegar +T1: 60⁰C). Whereas the maximum browning index (0.883, 0.913 and 0.917) was found in treatment T1: (P0: Control +T1: 60⁰C) in tray drying method. The minimum browning index (0.323, 0.343 and 0.363) was found in treatment T2: (P1: Vinegar +T1: 60⁰C). Whereas the maximum browning index (0.887, 0.920 and 0.933) was found in treatment T1: (P0: Control +T1: 60⁰C) in vacuum drying method.

3.3 Temperature and treatment effect on Water retention of Oyster mushroom in Tray and vacuum drying method

Treatments	Tray dryer			Vaccum dryer		
	White Oyster Mushroom	Grey Oyster Mushroom	Pink Oyster Mushroom	White Oyster Mushroom	Grey Oyster Mushroom	Pink Oyster Mushroom
P0: (Control)	4.572	5.247	5.569	4.921	5.569	5.892
P1: (Vinegar)	3.400	4.093	4.440	3.747	4.440	4.787
P2: (Lemon Juice)	4.367	5.086	5.448	4.727	5.448	5.807
F-Test	S	S	S	S	S	S
C.D. at 0.5%	0.112	0.094	0.104	0.089	0.104	0.110
S.Ed. (+)	0.053	0.045	0.049	0.042	0.049	0.052
Temperature						
T1: 60°C	4.020	4.721	5.057	4.382	5.057	5.393
T2: 70°C	4.123	4.797	5.133	4.460	5.133	5.470
T3: 80°C	4.196	4.908	5.267	4.552	5.267	5.622
F-Test	S	S	S	S	S	S
C.D. at 0.5%	0.112	0.094	0.104	0.089	0.104	0.110
S.Ed. (+)	0.053	0.045	0.049	0.042	0.049	0.052
Interaction (Treatment x Temperature)						
T1: (P0: Control +T1: 60 °C)	4.690	5.333	5.610	5.047	5.610	5.890
T2: (P1: Vinegar +T1: 60 °C)	3.187	3.887	4.237	3.537	4.237	4.587
T3: (P2: Lemon juice+ T1: 60 °C)	4.183	4.943	5.323	4.563	5.323	5.703
T4: (P0: Control +T2: 70 °C)	4.583	5.243	5.573	4.913	5.573	5.903
T5: (P1: Vinegar +T2: 70 °C)	3.430	4.110	4.450	3.770	4.450	4.790
T6: (P2: Lemon juice +T2: 70 °C)	4.357	5.037	5.377	4.697	5.377	5.717
T7: (P0: Control+T3: 80 °C)	4.443	5.163	5.523	4.803	5.523	5.883
T8: (P1: Vinegar +T3: 80 °C)	3.583	4.283	4.633	3.933	4.633	4.983
T9: (P2: Lemon juice+T3: 80 °C)	4.560	5.277	5.643	4.920	5.643	6.000
F-Test	S	NS	S	S	S	S
C.D. at 0.5%	0.194	0.163	0.179	0.154	0.179	0.190
S.Ed. (+)	0.092	0.077	0.085	0.073	0.085	0.090

Table 3.3 Temperature and treatment effect on Water retention of Oyster mushroom in Tray dryer and vacuum dryer method

Figure 3.3 Temperature and treatment effect on Water retention (%) of Oyster mushroom Tray dryer and Vacuum dryer



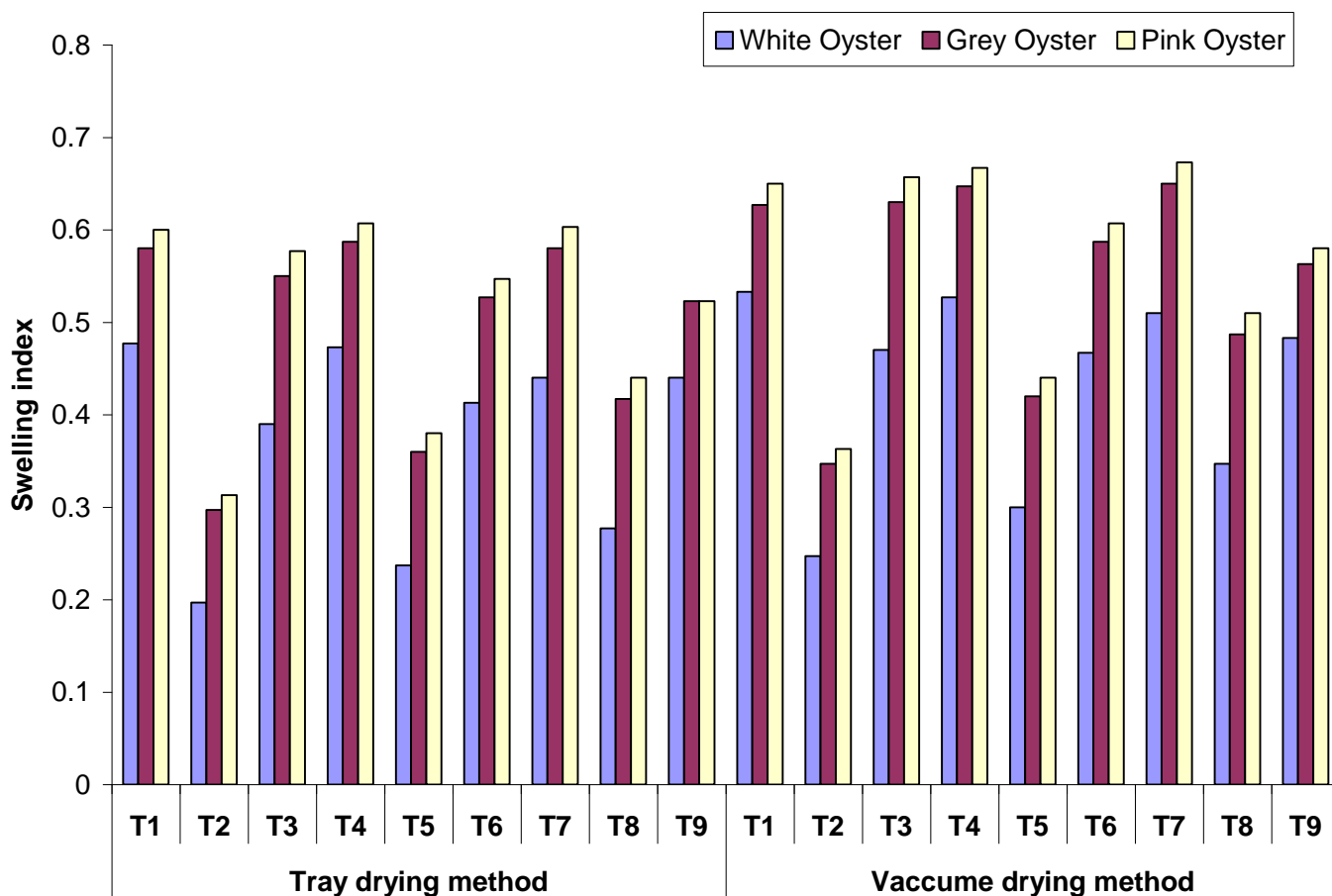
From the table 3.3 and fig. 3.3 it has concluded that there is minute effect of three pre-treatment viz., (Control, Vinegar and Lemon juice) and three temperature viz., (60, 70 and 80⁰C) on water retention of white, grey and pink oyster mushroom. The minimum water retention (3.187, 3.887 and 4.237) was found in treatment T2: (P1: Vinegar +T1: 60⁰C). Whereas the maximum water retention (4.690, 5.333 and 5.610) was found in treatment T1: (P0: Control +T1: 60⁰C) and T9: (P2: Lemon juice+T3: 80⁰C) in tray drying method. The minimum water retention (3.537, 4.237 and 4.587) was found in treatment T2: (P1: Vinegar +T1: 60⁰C). Whereas the maximum water retention (5.047, 5.643 and 6.000) was found in treatment T1: (P0: Control +T1: 60⁰C) and T9: (P2: Lemon juice+T3: 80⁰C) in vacuum drying method.

3.4 Effect of temperature and treatment on swelling index of Oyster mushroom in Tray and vacuum drying method

Treatments	Tray dryer			Vaccum dryer		
	White Oyster Mushroom	Grey Oyster Mushroom	Pink Oyster Mushroom	White Oyster Mushroom	Grey Oyster Mushroom	Pink Oyster Mushroom
P0: (Control)	0.463	0.582	0.603	0.523	0.641	0.663
P1: (Vinegar)	0.237	0.358	0.378	0.298	0.418	0.438
P2: (Lemon Juice)	0.414	0.533	0.549	0.473	0.593	0.614
F-Test	S	S	S	S	S	S
C.D. at 0.5%	0.028	0.039	0.105	0.057	0.055	0.099
S.Ed. (+)	0.013	0.019	0.049	0.027	0.026	0.047
Temperature						
T1: 60°C	0.354	0.476	0.497	0.417	0.534	0.557
T2: 70°C	0.374	0.491	0.511	0.431	0.551	0.571
T3: 80°C	0.386	0.507	0.522	0.447	0.567	0.588
F-Test	S	NS	NS	NS	NS	NS
C.D. at 0.5%	N/A	N/A	N/A	N/A	N/A	N/A
S.Ed. (+)	0.013	0.019	0.049	0.027	0.026	0.047
Interaction (Treatment x Temperature)						
T1: (P0: Control +T1: 60 °C)	0.477	0.580	0.600	0.533	0.627	0.650
T2: (P1: Vinegar +T1: 60 °C)	0.197	0.297	0.313	0.247	0.347	0.363
T3: (P2: Lemon juice+ T1: 60 °C)	0.390	0.550	0.577	0.470	0.630	0.657
T4: (P0: Control +T2: 70 °C)	0.473	0.587	0.607	0.527	0.647	0.667
T5: (P1: Vinegar +T2: 70 °C)	0.237	0.360	0.380	0.300	0.420	0.440
T6: (P2: Lemon juice +T2: 70 °C)	0.413	0.527	0.547	0.467	0.587	0.607
T7: (P0: Control+T3: 80 °C)	0.440	0.580	0.603	0.510	0.650	0.673
T8: (P1: Vinegar +T3: 80 °C)	0.277	0.417	0.440	0.347	0.487	0.510
T9: (P2: Lemon juice+T3: 80 °C)	0.440	0.523	0.523	0.483	0.563	0.580
F-Test	S	S	NS	NS	NS	NS
C.D. at 0.5%	0.048	0.068	N/A	N/A	N/A	N/A
S.Ed. (+)	0.023	0.032	0.086	0.046	0.045	0.081

Table 3.4 Temperature and treatment effect on swelling index of Oyster mushroom in Tray dryer and vacuum dryer method

Figure 3.4 Temperature and treatment effect on swelling index of Oyster mushroom Tray dryer and Vacuum dryer



From the table 3.4 and fig. 3.4 it has concluded that there is minute effect of three pre-treatment viz., (Control, Vinegar and Lemon juice) and three temperature viz., (60, 70 and 80⁰C) on swelling index of white, grey and pink oyster mushroom. The minimum swelling index (0.197, 0.297 and 0.313) was found in treatment T2: (P1: Vinegar +T1: 60⁰C). Whereas the maximum swelling (0.477, 0.587, 0.607) was found in treatment T1: (P0: Control +T1: 60⁰C) and T4: (P0: Control +T2: 70⁰C) in tray drying method. The minimum swelling index (0.247, 0.347 and 0.363) was found in treatment T2: (P1: Vinegar +T1: 60⁰C). Whereas the maximum swelling index (0.533, 0.650, 0.673) was found in treatment T1: (P0: Control +T1: 60⁰C) and T7: (P0: Control+T3: 80⁰C) in vacuum drying method.

CONCLUSIONS

Several pretreatments and drying techniques were used in the current investigation to compare the best treatment and temperature to obtain good quality dried oyster mushroom with suitable dryer. After drying the following results were obtained for the physical characteristics of oyster mushroom.

- The minimum yield (%) (5.903, 5.773 and 5.693) of white, grey and pink oyster mushroom was found in treatment T2: (P1: Vinegar +T1: 60 °C) in tray drying method. The maximum yield (%) (6.993, 6.863 and 6.783) was found in treatment T2: (P1: Vinegar +T1: 60 °C) in vacuum drying method.
- The minimum browning index (0.303, 0.323, .343) of white, grey and pink oyster mushroom was found in treatment T2: (P1: Vinegar +T1: 60 °C) in tray drying method. The maximum browning index (0.323, 0.343 and 0.363) was found in treatment T2: (P1: Vinegar +T1: 60 °C) in vacuum drying method.
- The minimum water retention (3.187, 3.887 and 4.237) of white, grey and pink oyster mushroom was found in treatment T2: (P1: Vinegar +T1: 60 °C) in tray drying method. The maximum water retention (3.537, 4.237 and 4.587) was found in treatment T2: (P1: Vinegar +T1: 60 °C) in vacuum drying method.
- The minimum swelling index (0.197, 0.297 and 0.313) of white, grey and pink oyster mushroom was found in treatment T2: (P1: Vinegar +T1: 60 °C) in tray drying method. The maximum swelling index (0.247, 0.347 and 0.363) was found in treatment T2: (P1: Vinegar +T1: 60 °C) in vacuum drying method.

REFERENCES

- Aremu, M. O., Basu, S. K., Gyar, S. D., Goyal, A., Bhowmik, P. K., & Banik, S. D. (2009). Proximate Composition and Functional Properties of Mushroom Flours from *Ganoderma* spp., *Omphalotusolearius* (DC.) Sing. and *Hebelomamesophaeum* (Pers.) Quél. sed in Nasarawa State, Nigeria. *Malaysian journal of nutrition*, 15(2).
- Bazyma, L. A., & Kutovoy, V. A. (2005). Vacuum drying and hybrid technologies. *Stewart Postharvest Review*, 4(7).
- Kusuma, I. W., Arung, E. T., & Kuspradini, H. (2019). The potential of white-oyster mushroom (*Pleurotusostreatus*) as antimicrobial and natural antioxidant. *Asian Journal of Natural Product Biochemistry*, 17(1).
- Misha, S., Mat, S., Ruslan, M. H., Sopian, K., & Salleh, E. (2013). The prediction of drying uniformity in tray dryer system using CFD simulation. *International Journal of Machine Learning and Computing*, 3(5), 419.
- Pereira, E., Barros, L., Martins, A., Ferreira, I.C.F.R., 2012. Towards chemical and nutritional inventory of Portuguese wild edible mushrooms in different habitats. *Food Chem.* 130, 394–403.
- Singh, R. (2017). A review on different benefits of mushroom. *IOSR Journal of Pharmacy and Biological Sciences*, 12(1), 107-11.