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Quality attributes of bottle gourd (Lagenaria Siceraria) dried in natural convection domestic solar dryer.

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Abstract---Thenatural convective domestic dryer has been designed and fabricated in conformity with the atmospheric conditions of Kashmir Valley. Bottle gourd was dehydrated in the dryer and samples were analyzed for quality attributes. The drying time has reduced to 22 hours, water activity of the sampleis restricted to low value (0.349) leading to constrained microbial growth. Moisture content of the dried samples is found to be 2.842 % which is significantly small in comparison to open sun-dried sample (10.18 %). Non-enzymatic browning results shows the absorbance value of 0.042 indicating transmittance of 90% while as the samples dried in open sun have absorbance of 0.198 (transmittance of 65%). The significance of the result was confirmed by using the one sample T-test which showed significant difference between the Solar dried and open dried samples.

Keywords---Ascorbic acid, Dehydration, Moisture content, Rehydration, Water activity.

Highlights

It highlights the importance of use of Solar Energy in day to day life. Economic analysis of the designed dryer has shown that it is financially attractive to the user. The dryer is user friendly in terms of operation and handling due to simplicity of design and being light in weight. There is an urgent need to

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disseminate the design to large masses so that access to safer and better dried vegetables in lean season in a sustainable way is provided to the common masses.

Introduction

Kashmir province constitutes the northern most extremity of India. It experiences harsh weather from November to April owing to which there is severe scarcity of vegetables while as there is copious growth of vegetables throughout summer season. Bottle Gourd (Lagenaria Siceraria)belongs to the family of Cucurbitacae. They are the first food plants grown in America quoted by Verma (2013). Natives near the northern coast of Peru grew them almost 5000 years ago and called them bottle gourd. Its vines have heart shaped leaves, white flowers and fruits which are sometimes very long. The bottle shaped gourds are 3500 years old. It is a good source of vitamin B, vitamin C and fibre. Fruit pulp is cooling, diuretic and anti-bilious in nature, it is considered good for people suffering from insomnia, heart problems and diabetes described by Gopalan et al.(2000) in his paper. Thebottle gourd contains total soluble solids (3.5° Brix), acidity (0.12 %) carbohydrates (2.9 %), protein (0.2 %), fat (0.1 %), minerals (0.5 %), fibre (0.6 %), thiamine (0.044 mg), riboflavin (0.023 mg), niacin (0.33 mg) and ascorbic acid (13 mg) per 100 g (Desai et al.1998). It is a fleshy vegetable having water content of 75-85 % attributable to it takes extended time to dry.

It is the most abundant vegetable grown in Kashmir division during the summer season which leads to its excess production and people prefer to dry this vegetable at home for the consumption during the harsh winter season when there is lack of vegetation (Kumar et al. 2005). Dehydration is one of the primordial and rampant techniques for safeguarding food quoted by numerous people like Lima (2002) andRatti(1997). By and large the people in Kashmir division dehydrate vegetables in open sun due to lack of knowledge regarding the solar dryers and high capital costs of the Electric dryers. Solar Energy has highest potential to be used in the developing countries as it is renewable source and is environment friendly. Harnessing of this energy for dehydration will save electrical energy and hence conserve the fossil fuels. Though there are numerous types of dryer available and many people have reported uses of dryers (Pirasteh et al.2014). There are several drawbacks associated with the open sun drying like being unprotected from rain, wind-borne dirt and dust, infestation by insects, rodents and other animal. It makes open sun dried vegetables unhealthy for consumption and below the international standards of quality as reported by Ayensu(1997, 121-126), Belessiotis et al. (2011). In order to overcome the drawbacks associated with the open sun drying a low cost dryer has been designed for households which is portable and can be easily handled by anyone. The performance of the dryer was evaluated by drying the bottle gourd in the dryer and performing the different tests on the dried vegetable post drying.

Dryer Design

While fabricating the dryer diverse characteristics are required to be kept in consideration so that fabricated dryer is apposite for a particular expanse. The amount of radiation and relative humidity of the place are main features to design a dryer. The data of relative humidity and radiation data is procured from the

Indian Metrological Department (IMD) Srinagar which has been plotted in figure 1. The physical parameters of the dryer are its thermal efficiency, final quality of the product and the dryer's economic viability. Proper design of domestic solar dryer must be implemented in order to achieve the objectives. The design parameters of the solar dryer of desirable features are given inTable-1.

The dryer consists of a drying chamber having two mesh trays for loading vegetables. The dimensions of dryer are: Height = 90 cm, length = 90 cm, breadth = 62 cm; spacing between trays = 40 cm. The dryer is covered with a transparent UV stabilized polyethylene cover of 0.2 mm thickness which is not affected by the atmospheric conditions and has transmissivity of 92% for visible radiation and thus traps the solar energy leading to the greenhouse effect and enhance the temperature inside the dryer to maintain it at optimum level for drying of vegetables. The top surfaces of the collector and drying chamber have been designed in a dome shape in order to increase the area for radiation. The advantage of dome is to maximize utilization of solar radiation and enhances the amalgamation of air inside the dryer. The shape and orientation plays an important role in the dryer (Odesola, 2012). The dryer is provided with an air inlet and outlet vents measuring 5cm in diameter at the front and top, respectively. The outlet vent is on the upper side to remove hot air and inlet valve is below the lower tray. The vents have sliding covers which control air inflow and outflow.

The movement of air through the vents, when the dryer is placed in the path of airflow, brings about a thermo-siphon effect which creates an upward movement of solar heated air consisting of moisture and moves it out of the drying chamber. The source of air is natural flow which does not require an exhaust fan. Since Natural convection dryers do not require a fan to pump the air through the dryer. Thus the effort was done on designing and constructing a simple natural convection dryer. For the convenience the dryer is provided with two sliding perforated trays for loading of vegetables which move freely inside the dryer. The dryer is made from the locally available willow /wicker work which is very light in weight and thus can be easily handled. The domestic dryer and sketch of the prototype dryer is shown in Figure 2(a) and Figure 2(b) respectively.

Methodology

The bottle gourd was procured from the local kitchen garden for drying experiment. It was peeled, washed and sliced to the dimensions 15cm to 20cm approximately in length and 2 cm to 2.5cm in width measured using the vernier calipers as can be seen in Figure 3(a). Gourd slices were not treated in any chemical before drying. The weight of washed gourd was found to be 1.76 kg. The slices were spread evenly in a single layer on the trays of the dryer and dryer was closed. Initially the temperature of the dryer was recorded as 48° C, which increased to 55° C though the outside temperature was 31°C. The increasing temperature inside the dryer was noted and is summarized in Figure 4.

Due to elevated temperature inside the dryer the removal of moisture is very fast from the pieces of the bottle gourd. At the end of day it was observed that the pieces were dried partially without the exposure of pieces to the direct sunlight. During the drying experiment, the temperature was measured by a thermometer.

The initial loss in the moisture was determined by difference in the weight of the sample resulting from the weighing by a sensitive balance. Reduction of moisture weight was recorded by weighing the sample every hour and it was noticed that the temperature of dryer increased gradually. The sample was allowed to sit in the dryer during night. Subsequently by the end of the other day it was observed that the sample had dried completely but was still allowed to remain in the dryer for one more time to remove some bound moisture. The bound moisture is not visible but is left behind in the dried products and can become the cause of its deterioration. Though microbial growth is not promoted by bound moisture, but should be removed in order to increase the shelf life of the product. On third day it was found that the weight of the sample had reduced to 90 grams as compared to initial weight of 1.76 kg which is a huge loss in weight that indicate the loss of moisture content from the vegetable and reduced water activity. The dimension of gourd slices reduced to around 10 cm and width 0.5 cm as can be seen in Figure 3(c). The OSD sample can be seen in Figure 3 (b) showing the blackish colour due to fungal growth.

Quality Attribute testing

The quality of the product is determined by several physio-chemical parameters like water activity, moisture content, non-enzymatic browning, color, rehydration ratio etc. These factors determine whether the product is healthy for human consumption and how much the spoilage of foodstuff is reduced.

Moisture Content

The moisture content in the vegetables becomes major cause for their spoilage during the preservation period. If the value of moisture content exceeds 10% which is measured in terms of g/m^3 it leads to expansion of microorganisms in food Ong (2010). Therefore it becomes imperative to trim down the value of moisture content so as to boost the shelf life of the produce.

Water Activity

Water Activity (aw) is one of the most decisive factors in determining superiority and safety of food. It influences the life span, safety, texture, flavor and smell of foods. For every foodstuff there exists water activity limit below which microorganisms stop to nurture(Jangam 2012). Reducing the value of water activity may be imperative for controlling spoilage of food, which is done by drying usually. Water activity is calculated by the formula given by Ranganna (1986) expressed as

$$a_w = P/Pw$$

a_w= water activity and is ratio of partial pressure, hence unit less
P= partial pressure of water over the wet solid system
P_w = equilibrium partial pressure of water at same temperature

Non- Enzymatic Browning

The deterioration rates of non enzymatic browning reactions are closely related to temperature and water activity, the browning rate decelerates at low water activity values because solute mobility is limited below the monolayer. Mostly the discoloration rate increases with water activity which has been demonstrated by Sachin (2010),Goula (2006),Labuza (1972),Maskan (2002), McMinn (1997)Rapusas (1995). Browning in eatables is maximum at water activity value of 0.5 -0.8 (Topuz 2008, Lueng 1987) which leads to the Milliard reactions in the food.

Colour attributes

Colour is an important attribute of the food which determines the acceptance by the consumers. Evaluation of colour was done by a non destructive method, using the CIELAB colour space (L* a* b*) which represents dark-black (0) to light-white (100) spectrum, green (-60) to red (+60) spectrum, blue (-60) to yellow spectrum (+60) Abbott (1999). Total colour change is given by ΔE and Chroma (C*)as proposed by Chen (2008) given below:

$$C^* = \sqrt{a^{*2} + b^{*2}}$$

$$\Delta E = \sqrt{(\mathrm{L}* - \mathrm{L}*_{\mathrm{ref}})^2 + (\mathrm{a}* - \mathrm{a}*_{\mathrm{ref}})^2 + (\mathrm{b}* - \mathrm{b}*_{\mathrm{ref}})^2}$$

C* and ΔE were calculated for both Sun dried samples and open dried samples. Samples dried in Solar drier yielded lower values in comparison to open sun dried samples and hence will have more acceptance by the user. Hue angle, H*is the attribute of colour that is related to the perceived colour. Hue angle measures the color of the sample or what the eye is able to perceive as is given by Mohammadi et al. (2008) which is expressed by the equations given below.

$$H^* = \tan^{-1}\left(\frac{b^*}{a^*}\right), for\ a > 0, b > 0$$

$$H^* = 180 + \tan^{-1}\left(\frac{b^*}{a^*}\right), for\ a < 0, b > 0 : and\ for\ a < 0, b < 0$$

$$H^* = 360 + \tan^{-1}\left(\frac{b^*}{a^*}\right), for\ a > 0, b < 0$$

Vitamin C determination

Vitamin C is heat and light sensitive vitamin and its loss depends on the exposure to light and the duration for which it is exposed to light and has been explained byGupta (2012). Since it is a water soluble vitamin, its value is reduced by cutting and washing (Tannenbaum 1985**).** The bottle gourd has only (13 mg) per 100 g of Vitamin C in its fresh form (Desai 1998). The dried sample was tested for the presence of Vitamin C, in order to find out how much Vitamin C has been destroyed due to drying and exposure to the sun.

Rehydration Ratio

For performing this, test 5 g of samples were dipped in 60 ml of water and covered with a watch glass. The sample was heated gradually and brought to boil. Boiling continued for 20 minutes after which sample was removed from the water and excess water was strained from it. The sample was again weighed. The rehydration ratio was calculated using the formula given by Srivastava (1993)

$$Rehydration\ ratio = B/A$$

B = weight of sample after rehydration
A = weight of sample before rehydration

Proximate composition

Proximate compositions of dried gourd slices were determined by recommended methods of the American Official Analysis Chemist (AOAC, 1984) such as carbohydrate, protein, crude fibre and ash. All trial runs were performed in triplicate.

Result and Discussion

Moisture Content

Moisture content test was conducted by the Halogen based Moisture analyzer. The initial moisture content of bottle gourd in its raw state was found to be 92 %. The open sun dried samples were tested on the same analyzer by making the paste of 5g sample and placed in the tray of the Analyzer. The moisture content value was found to be 10.18 %. For the samples dried in Solar Dryer, it was found that the moisture was reduced to 2.842 % which is good in terms of the microbial growth. If the value of moisture content exceeds 10% it can lead to microbial growth (Ong 2010) Comparison of the moisture content for open sun dried vegetable and solar dried vegetable is given in Figure 5.

Water Activity

The water activity test was performed on Pre Aqua lab water activity analyzer at SKAUST Kashmir. The analyzer was first heated for 45 minutes and then ground samples were placed in the chamber for 5 minutes. It was found that the samples dried in open sun have value of $a_w$as 0.728 For the samples dried in Solar Dryer the value of a_w is 0.389 which is considerably good value for stopping the growth of microbes, fungus etc as reported by Chen (2008). The comparative values of water activity are given in Figure 6.

Non- Enzymatic Browning

The value of absorbance of UV in the sample extract at 420 nm wavelengths is taken as a measure of non enzymatic browning. A sample of 5 g of dehydrated ground gourd was soaked in 100ml of 60% alcohol for 24 hrs and then filtered. Absorbance of the filtrate was recorded at 420nm with the help of a spectrophotometer using 60% alcohol as blank and the observation were expressed in terms of optical density given by Labuza (1972). The analysis done here revealed that the samples dried in open sun have more browning in comparison to the samples dried in Solar Dryer. The absorbance of open sun dried sample was found to be 0.198 which indicates the transmittance of 65%. While as the sample dried in solar dried had absorbance of 0.042 and hence transmittance is 90%.The change in color is linked with the changing nutritional value. The solubility cause degradation of flavor and induces textural changes.

Colour attributes

Higher the value of Hue angle less browning it indicates and vice versa, while chroma is a measurement of strength of colour such as intensity or saturation.(Villamiel 2006). From the analysis (L* a* b*) values for the Open Sun Dried samples was found to be L* is 10.79, a* is 06.65, b* is 46.19. The values for Solar Dried samples was L* is 51.32, a* is - 0.29, b* is 28.16. The values of ΔE, Hue angle and chroma were calculated and are summarized in Table 2.This indicates the better results for the samples dried in the solar dryer in terms of colour, hence the acceptance by the consumers.

Ascorbic Acid determination

The determination of Vitamin C in the fresh and the dried samples was done by 2,4-Dichlorophenol Indo-phenol dye method. The dried samples were soaked in water for four hours and then ground to paste so that the content of vitamin C will be determined perfectly. In the samples dried in open sun presence of Vitamin C was almost negligible and in Solar dried sample it was found to be around (5 mg) per 100 g which is significantly low but better than open sun dried sample. It indicates that during cutting, washing, drying of bottle gourd Vitamin C is degraded. Moreover it indicates that the open sun drying completely destroys the Vitamin C content in the food.

Rehydration Ratio

The rehydration ratio was found maximum for sample dried in Solar dryer in comparison to the sample dried in open sun as evident in Figure 7. During the drying process cell rupture and dislocation takes place due to which the tissue integrity is lost and the capillaries shrink. It results in the reduced imbibitions of the water and leaves the unfilled pores (Krokida2000).

Proximate composition

The protein content in solar dried sample was higher than that of open sun dried and is considered to be rich in protein.The crude fibre content in solar dried sample was 1.03%, while the total ash content was found to be 1.08 per cent. The total carbohydrate content was calculated to be 1.52 g in solar dried sample. The performance of the dryer in terms of different variables like moisture content, water activity, Vitamin C, transmittance is summarized in Table: 3. The proximate composition of the fresh and dried samples is presented in Table 4.The comparison of raw, solar dried and open sun dried samples in the table demonstrate the better performance in terms of the quality for solar dried products.

Economic evaluation

Working performance of solar dryer is based on several factors and benefits derived from the dryer. These benefits indicate the feasibility of dryer in terms of handling, maintenance and usage. Subsequently the economics of this dryer was evaluated in terms of cost of the dryer which is INR 2000/. This dryer doesn't require any maintenance cost during or after its operation. The capital investment cost is very low in comparison to the mechanical dryers or electric dryers. In a season it can dry up to 150 kg of vegetables. It pays back its cost in one season only. The useful life of this dryer is about ten years

Conclusion

Finest quality and aesthetically appealing dried gourd slices are obtained by solar drying. The quality of the dried product on the basis of moisture content, water activity, colour attributes, vitamin C retention and rehydration ratio determines that the solar dried products are significantly good as indicated by the T- test. The samples are dried in hygienic conditions and drying time has reduced significantly. During drying there is very less chance of samples being exposed to rain, birds and are prevented from the direct exposure to the Sunlight which prevents the UV- exposure and make dried vegetables safe for consumption. The designed dryer is uncomplicated, portable, light weight, economic and occupies less space, thus is user friendly and can be easily handled.

Conflicts of Interest: The authors declare no conflict of interest

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References

Abbott,J.A.(1999) Quality measurement of Fruits and Vegetables, Postharvest Biology and Technology, 15, pp. 207-225

Allugunti V.R (2022). A machine learning model for skin disease classification using convolution neural network. International Journal of Computing, Programming and Database Management 3(1), 141-147

AyensuA(1997) Dehydration of Food Crops using a Solar Dryer with Convection Heat Flow, *Solar Energy*,59(4/6),pp. 121-126

Belessiotis V.Delyannis E (2011) Solar drying, Solar Energy, 85, No. 8, 1665–1691

Chen, X.D. (2008) Food drying fundamentals, pp. 1-54, in In X.D. Chen and AS. Maujumdar [eds.] Drying Technologies in Food Processing, West Sussex, Blackwell Publishing.

Desai, U.T., Musmade, A.M. (1998) Pumpkins, squashes and gourds in Handbook of vegetable science and Technology (Edited by Salunkhe, D.K. and Kadam, S.S.) marcel Dekker Inc. PP. 279-282.

Ghita, D. ., Ahmad, M. ., Budi, P., Liantanty, F. ., & Ahmar, H. . (2021). Effect of e-module stage iv childbirth care with blended learning model on skills improvement of midwifery students. International Journal of Health & Medical Sciences, 4(1), 110-116. https://doi.org/10.31295/ijhms.v4n1.1527

Gopalan, C. Rama Sastri, B.V. and Balasubramanian (2000). Nutritive value of Indian Foods. National Institute of Nutrition, Hyderabad, ISBN: 0727913751

Goula, A.M., and Adamopoulos, K.G. (2006) Retention of Ascorbic Acid During Drying of Tomato Halves and Tomato Pulp, Drying Technology 24 (1); 57-64.

Gupta M.K., Sehgal V.K. et al (2012) Effect of process parameters and storage length on quality of dried cauliflower during storage, Indian Journal of Traditional Knowledge, Vol. 11(1) 177-184

KrokidaM,K., Karanthano V.L.&Maroules Z.B.(2000), Compression analysis of dehydrated agricultural product, Drying Technology, 18 (1-2) 395 - 408

Kumar A., Kadam D.M,.ThawareJ.B,. Bhagat I. B (2005) Performance of gothic shape with vertical sidewall greenhouse structure in cold desert region of India for crop production. Plasticulture II Epoca124:90–105

Kumar, S. (2022). A quest for sustainium (sustainability Premium): review of sustainable bonds. Academy of Accounting and Financial Studies Journal, Vol. 26, no.2, pp. 1-18

Labuza, T.P., and Tannenbaum, S.R(1972), Nutrient Losses During Drying and Storage of Dehydrated foods. Critical reviews in Food Science and Nutrition 3(3) ; 167-190

Lima AGB, Quiezor MR, and Nebra SA,(2002) Simultaneous moisture transport and shrinkage during the drying of solid ellipsoidal configuration, Chem. Eng. Journal 86 85-93.

Lueng, H.K., (1987) Influence of WterActivityy on Chemical Reactivity. In Water Activity: Theory and Application to Food, edited by by Rockland, L.B., and Beuchat, L.R., New York; Marcel Dekker, Inc.

Maskan A., Kaya, S., and Maskan, M.(2002), Effect of Concentration and Drying Processes on Color Change of Grape Juice and Leather (Pestil) . Journal of Food Engineering 54(1): 75-80.

McMinn, W.A.M and Magee, T.R.A. (1997). Kinetics of Ascorbic Acid Degradation and Noon-Enzymatic Browning in Potatoes; Food and Bioproducts Processing 75 (4); 223-231.

MohammadiA,.S Rafiee,., Z Emam-Djomeh,. and A Keyhani(2008) “Kineticmodels for colour changes in Kiwifruit slices during hot air drying”.World Journal of Agricultural Sciences, 4 (3): 376–383.

Odesola, I. F. and Ezekwem, Chidozie, The effect of shapeand orientationon a greenhouse: A review, an international joural of Science and technology, I, 2012, 2225-8612

Ong, S.P. and Law,C.L. Hygrothermal Properties ofvarious Foods, Vegetables and Fruits, in DryingofFoods, Vegetables and Fruits- Volume 1, Ed. Jangam, S.V.,Law, C.L. and Mujumdar, A.S., 2010, ISBN – 978-981-08-6759-1, Published in Singapore, pp. 31-58.

PirastehG, Saidur R, Rahman S.M.A, Rahim N.A(2014)Renewable and Sustainable Energy Reviews31133–148

Ranganna S, (1986) Handbook of Analysis and Quality Control for Fruits and Vegetable Products. 2ndedn. (Tata McGraw hill publishing company limited, New Delhi), 497-528

Rapusas, R.S. and Driscoll, R.H. (1995) Kinetics of Non- Enzymatic Browning in Onion Slices During Isothermal Heating journal of Food Engineering 24(3); 417-429

RattiC., and MujumdarA.S. (1997) Solar Drying of Foods: Modelling and Numerical Simulation, *Solar Energy*, 60(3/4), pp.151-157

Sachin V., Jangam, Chung Lim, Law. (2010) Drying of Foods, vegetables and Fruits (Volume 1), ISBN 978-981-08-6759-1

Srivastava R. P., Kumar S. (1993) Fruits and Vegetable Preservation Methods and Practices, (International Book Distribution Co, Luckhnow)

Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2022). Post-pandemic health and its sustainability: Educational situation. International Journal of Health Sciences, 6(1), i-v. https://doi.org/10.53730/ijhs.v6n1.5949

Tannenbaum, S.R., Young V.R., Archer, M.C. (1985) Vitamins and Minerals, In Food Chemistry edited by Fennena, O.R., New York Marcel Dekker, Inc.

Topuz, A. (2008) A novel Approach for Color Degradation Kineticsof Paprika as a function of Water Activity. LWT-Food Scienceand Technology41 (9): 1672-1677.

Verma V.(2013) Handbook of Econmic botany, Emkay Publications. ISBN: 9788180521676

Villamiel, M., del Castillo, M.D. and Corzo, N.(2006). Browning Reaction in Food Biochemistry & Food Processing edited by Hui, Y.H. USA: Blackwell Publishing.

Visavale,G.L.(2012) Principles, Classification and Selection of Solar Dryers. In Solar drying: Fundamental, Applications and Innovations, Ed. Hii., .L., Ong, S.P., Jangam, S.V. and Mujumdar, A.s., ISBN- 978-981-07-3336-0, Published in Singapore, pp. 1-50

Tables

Table 1
Design Specification of the Solar Dryer

Product to be dried	Vegetable
Initial moisture content	> 92 % wet base
Final moisture content	< 10 % wet base
Loading capacity	6-7 kgs
Drying duration	3 days
Average operating temperature	50 – 60 °C
Average solar radiation	5 kwh/m²

Table 2
Colour parameters for fresh, solar dried and open sun-dried Bottle Gourd

Vegetable State	Colour Parameters					
	L*	a*	b*	H*	Chroma	ΔE
Fresh	59.26	-01.52	27.19	266.79	27.23	33.67
Open sun dried	10.79	06.65	46.19	81.807	46.666	30.202
Solar dried	51.32	-00.29	28.16	269.409	28.161	26.50

Table 3
Comparison of Raw & Dried Gourd in terms of M.C., a_w, Vitamin C, Transmittance

S.No.	Type	Moisture content(%)	Water Activity	Vitamin C	Absorbance	Transmittance
1	Fresh	92±0.5	0.9± 0.1	13mg/100g	-	-
2	Open Sun Dried	10.18 ±0.5	0.728±0.1	nil	0.198	65%
3	Solar Dried	2.842±0.5	0.389±0.1	5mg/100g	0.042	90%
4	T-Test	Sig ($p<0.05$)	Sig($p<0.05$)	Sig($p<0.05$)	Sig($p<0.05$)	Sig($p<0.05$)
5	S.E. of Mean	0.05743	0.03036	0.02302	0.03344	0.0075

Table 4
Proximate composition of Fresh and dried Bottle Gourd

S.No.	Principle	Nutrient Value		
		Fresh	Solar Dried	OSD
1	Carbohydrates	3.38 g	1.52 g	0.04g
2	Protein	0.62g	0.15 g	0.01g
3	Total ash	2.03%	1.08%	0.02%
4	Crude fibre	3.43 %	1.03 %	0.00%

Figures

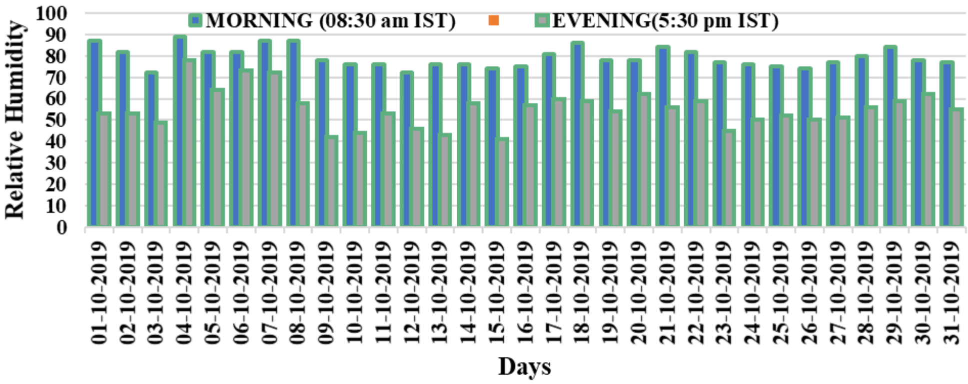

Figure 1. Relative humidity in Kashmir Division (Data from IMD, Srinagar)

Figure 2(a). Domestic Dryer

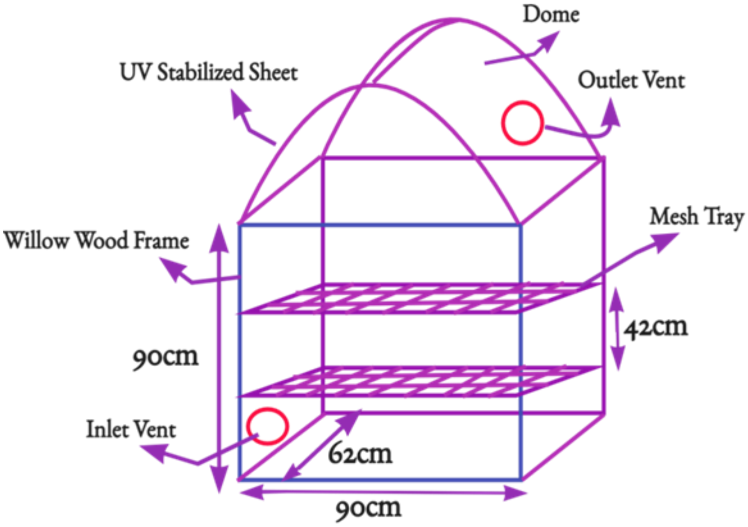

Figure 2(b). Sketch of the Prototype Domestic Dryer

Figure 3(a). Fresh slicesFigure 3(b) O.S.D. sample Figure 3(b): S.D. sample

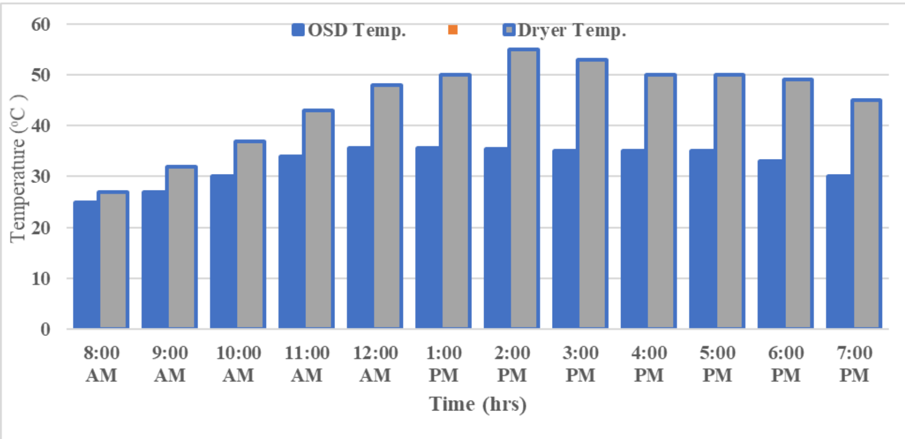

Figure 4. Variation of Temperature in a Domestic Solar Dryer

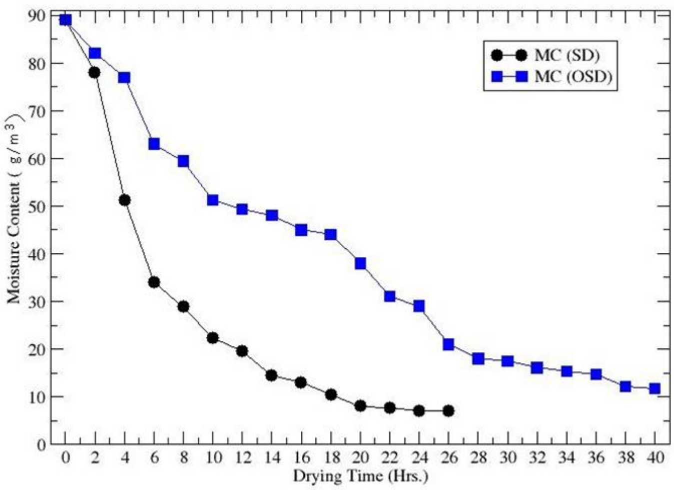

Figure 5. Comparison of Moisture content in OSD and Domestic Solar Dryer

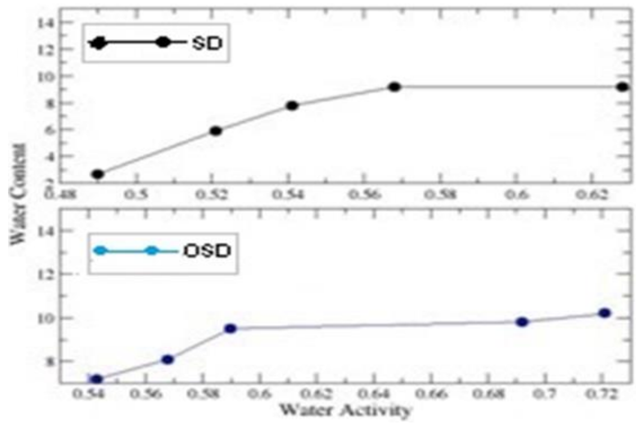

Figure 6. Variation of water activity and water content

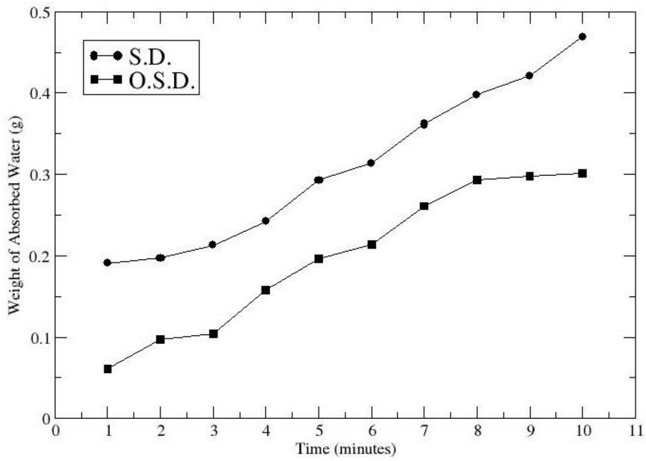

Figure 7. Variation of Absorbed water in Solar Dried and Open Sun Dried Samples