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Study of Sensory Parameters, Typical Macronutrients and Micronutrients of Dehydrated Cabbage using Cabinet Solar Dryer and Open Sun Drying Methods

G. V. Satpute, P. M. Dighe, V. M. Harpale

Abstract- Open sun drying of food product is the traditional method since ancient days. The recent technologies like vacuum drying, steam drying, spray drying, microwave drying etc. are used for drying food materials, need fuel or electricity making the procedure of drying costlier. The alternative to these is the solar dryer. Cabinet Solar Dryer is one of the dryers developed. It is cheaper, easy to handle and effective means for drying because using it solar energy can be utilized meaningfully. Solar energy being the renewable source of energy is abundant, available at free of cost, clean, pollution free and lasting for millions of years in future. In solar dryer safe and appropriate drying of food product from nutrition point of view can be done. Also the product is free from contamination. These are the advantages over open sun drying. In the present study, sensory parameters as colour, flavour, taste & texture, macronutrients like energy value, protein, carbohydrate, fat and dietary fibre as well as micronutrients (minerals and vitamins) like potassium, phosphorous, magnesium, calcium, iron and vitamin C were estimated in the sample of cabbage in both the methods, solar dryer as well as open sun drying. The results are noticeable.

Keywords: Fossil fuels, Energy Crisis, Insolation, Photothermal, Solar Dryer, Macronutrients, Micronutrients, Diet, Adequate Intake (AI), Recommended Dietary Allowance (RDA).

I. INTRODUCTION

The energy demand of a human being is continuously increasing as the standard of living is rising up. The use of enormous amount of energy, especially from fossil fuels, is leading to Energy Crisis [1,2]. The reserves of fossil fuels are limited and going to be depleted in coming years. So man is in search of alternative sources of energy. The right answer to this is the solar energy. The energy intercepted by the earth is 1.7×10^{14} kW. It is abundant, available at free of cost and pollution free. This energy can be used for thermal or electrical applications. It is much more than the demand if used meaningfully.

Due to drying of vegetables and fruits, their shelf life is increased. Also it becomes easy to store and transport such food products and use them whenever needed.

In dried vegetables there is an increased content of nutrients indicating that they are a concentrated source of nutrients, shown by Pallavi Joshi et al.,2010 [3]. Drying of agricultural products in the thermal drying due to solar insolation, involves vaporization of moisture within the product by heat and subsequent evaporation, Ahmed Abed Gatea, 2011[4].

In the process of drying, the drying rate is affected by weather conditions such as: solar insolation, temperature, relative humidity, wind velocity, moisture content of the product and duration of drying period. This is reported in the study of Rajeshwari and Ramlingam, 2012 [5].

Cabinet solar dryer is a photothermal device used for dehydration[6,7].Using the dryer safe dryipng(drying temp.about 60 ^{o}C to 65 ^{o}C, moisture content up to 12% - 15%,within specific period of time) of the food material can be done.

The present work focuses **comparatively** on different aspects like sensory parameters, macro & micronutrients of the dried cabbage sample in Cabinet Solar Dryer (CSD) and in Open Sun Dryer (OSD).

The field of human nutrition and the dieticians go with government regulations and the field is supported by its own voluntary certification board [8], professional associations and journals. The macro and micronutrients play a vital role in metabolism and metabolic ways as well as physical responses of a human body. So we need an adequate and balanced amount of these nutrients for optimal health.

1.1 The need & doses of macronutrients-

For good health, the recommended intake per day of macronutrients is necessary.

1) According to Food and Agriculture Organization of United Nations, the average minimum energy requirement per person per day is about 1,800 kcal (7,500 kJ) [9].

2) According to US & Canadian Dietary Reference Intake (DRI) guidelines, woman & man adults require 46 gm & 56 gm of protein per day respectively [10].

3)The Dietary Guidelines for Americans[11] recommends that 45-65% of total energy should get from carbohydrates(sugar, sweets,bread,cakes).An athlete weighing 60 kg, in the training period of 2 hours in a day, requires 1529 Calories(i.e.52% of total energy 2941 Calories),means the athlete requires 364 gram of carbohydrates per day.

Carbohydrates provide energy especially for the brain and the nervous system [12].

4) Fats serve as energy stores for the body, containing about 37.8 kJ(9 calories) per gm of fat.

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The recommendation is that 30% of your energy should be derived from fat. So the Recommended Daily Intake(RDI) is 70 grams of fat per day(based on an average diet of 8700 kJ).The recommended daily intake for saturated fat is 24 gram(based on deriving 10% of energy from saturated fats) [13].

5) The amount of fiber needed per day is based on age and gender group [14,15].The recommended amounts of fiber needed per day for male(Age 31-50 years) and female(Age 31-50 years) are 31 gram and 25 gram respectively.

The British Nutrition foundation recommends a minimum fibre intake of 18 gm / day for healthy adults [16].

1.2 The dose of typical micronutrients -

The dose of some necessary minerals & vitamins per day for adults is as follows:

Potassium- Adequate Intake (AI) of potassium should be 4700 mg/day.

Phosphorus- The recommended intake of phosphorus is 700 mg/day [17].

Magnesium- The Recommended Dietary Allowance (RDA) is 420 mg/day [18].

Calcium- The RDA ranges from 1000 to 1200 mg/day [19, 20].

Iron-Adults (man and woman) need 18mg of iron everyday [21].

Vitamin C -the RDA is 90 mg/day [22].

1.3 Improper Nutrient Consumption –

The healthy diet prevents many human health problems. Improper nutrient consumption (diet of poor or excess nutrients consumption) causes diseases such as scurvy [23,24] and kwashiorkor [25], health –threatening conditions like obesity [26,27] and metabolic syndrome [28] ; and such common chronic systemic diseases as cardiovascular disease [29,30], diabetes [31,32] and osteoporosis [33, 34, 35].

Attempt has been made to study quantitively the amount of macronutrients & micronutrients retained in the dehydrated cabbage.

II. EXPERIMENTAL

The dryer was designed and fabricated by making use of local materials and experts. Dehydration of cabbage was done by using cabinet solar dryer as well as in open sun drying. The dryer works on the principle of natural convection or natural circulation of air. The cabinet solar dryer is as shown in Fig 1.

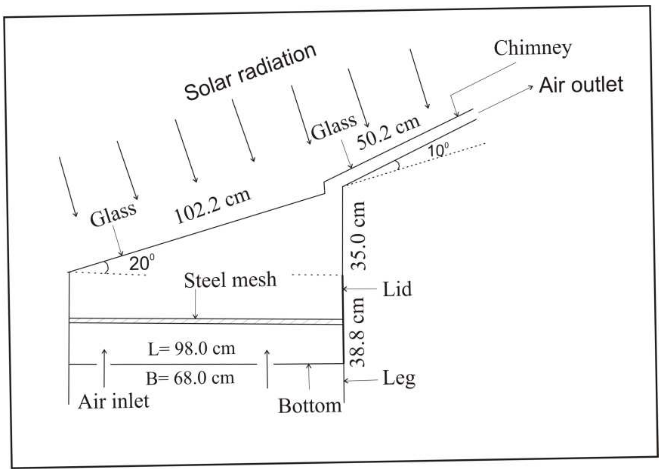

Figure 1: Cabinet Solar Dryer

During the process of dehydration, following points were important: The areas of mesh in the dryer and that of tray used in open sun drying were the same. Also the quantities of food stuff (cabbage) in both the cases were the same. The spreading of the material, cut into small pieces, over the mesh and tray was done in the similar fashion. The orientation of the dryer was along north – south direction. The time span chosen for dehydration was generally from 10.00 a.m. to 4.00 p.m. The opening of chimney was adjusted so as to achieve the proper cabinet temperature required for dehydration. The area of opening for hot air outlet through chimney was kept constant throughout. The loss in mass of the materials was noted after one hour or the same time interval in both the cases or continued further in open sun drying to achieve the final equal dehydration as in the dryer.

The temperature of surrounding air, cabinet air and air in chimney were measured by thermometers; the open space wind speed and hot air flow through chimney were measured by anemometer; open space insolation, insolation incident on cabinet and chimney surfaces were measured by Suryamapi(Solar insolation meter) and humidity of air by hygrometer.

III. RESULTS AND DISCUSSION

3.1 The Observations-

Observations taken are as follows-

i) Insolation-

Surrounding (open space), I_1= 706.9 W/m^2

Cabinet surface, I_2 = 808.7 W/m^2

Chimney surface, I_3= 815.4 W/m^2

ii) Temperature-

Surrounding (open space), t_1= 35.2 °C

Cabinet, below mesh, t_2=51.8 °C

Cabinet, above mesh, t_3=58.6 °C

Chimney, t_4= 68.1 °C

The temperatures clearly show the natural convection of air in the cabinet solar dryer as $t_4>t_3>t_2>t_1$.

iii) Wind speed-

Surrounding or open air wind speed = 1.82 m/s.

Speed of outlet hot air through chimney = 0.19 m/s.

iv) Humidity-

Surrounding air moisture = 55.09%

Note that all above values are the average values over the complete period of dehydration of the sample in the concerned modes.

v) Mass-

Mass of fresh cabbage sample= 500 gm

Mass of dehydrated cabbage sample= 47 gm

vi) Dehydration period-

Open sun drying = 10:00 hrs

Cabinet solar drying = 6:00 hrs

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3.2 Analysis of Sensory Parameters, Macronutrients and Micronutrients-

The analysis of the dehydrated samples of cabbage in CSD and OSD was done in National Agriculture and Food Analysis and Research Institute (NAFARI), Tilak Road, Pune, Maharashtra State, India 411002.

3.2.1 Sensory parameters-

Sensory parameters of the dehydrated cabbage sample in CSD and OSD are shown in Table 1.

Table 1

Sr. No	Parameters	Dehydrated cabbage powder in CSD	Dehydrated cabbage powder in OSD
1	Colour	Off white colour	Off white colour
2	Flavour	Cabbage Flavour	Poor Flavour, not Characteristic
3	Taste	Bitter	Bitter
4	Texture	Fibrous Texture	Smooth Texture

As referred to Table1-

It is observed that sensory parameters like colour and taste are the same in both the drying modes. It is worth noticing that even after dehydration the flavor of the sample is retained in CSD but not in OSD, indicating natural preservation of flavor in CSD, an important aspect and the point of merit. Due to high rate of drying in CSD, the texture becomes fibrous in it and due to slow rate of drying in OSD the texture of the sample is smooth.

3.2.2 Macronutrients-

In case of macronutrients, the Expected values calculated and Obtained values in the analysis, on the basis of 100 gm of fresh cabbage sample and equal mass of 100 gm of dried sample, in CSD and OSD are shown in Table2.

Table 2

Sr.No.	Macronutrient	Fresh sample value	Dehydrated sample value			Unit
			Expected value, CSD & OSD	Obtained value, CSD	Obtained value, OSD	
1.	Energy Value	27	287.23	344.00	340.00	kcal/100 gm
2.	Protein	1.8	19.15	12.80	12.70	gm/100 gm
3.	Carbohydrate	4.6	48.94	71.50	70.60	gm/100 gm
4.	Fat	0.1	1.06	0.72	0.75	gm/100 gm
5.	Dietary Fibre	2.8	29.79	26.10	-	gm/100 gm

As referred to Table2-

It is clear that the values of macronutrients like energy value, protein, carbohydrate, and and fat are comparable after dehydration in both the processes, but somewhat more in CSD (except fat) than in OSD. It is important to note that after dehydration, the obtained values of macronutrients as energy value, carbohydrate have been increased compared to the expected values. In case of protein it is found that the obtained values in CSD & OSD are less than the expected value because due to dehydration peptide linkage is broken and part of protein content is lost as shown by Srinivasan Damodharan, 1998[36]. The obtained values of fat in CSD and OSD are nearly the same but decreased compared to the expected value. This decrease may be due to the effect of drying temperatures to some extent in both the modes. The obtained and expected values of dietary fibre are comparable.

3.2.3 Micronutrients-

In case of micronutrients, the Expected values calculated and Obtained values in the analysis, on the basis of 100 gm of fresh cabbage sample and equal mass of 100 gm of dried sample, in CSD & OSD are shown in Table 3.

Table 3

Sr.No.	Micronutrient	Fresh sample value	Dehydrated sample value			Unit
			Expected value, CSD & OSD	Obtained value, CSD	Obtained value, OSD	
1.	Potassium	-	-	2112.16	1402.21	mg/100 gm
2.	Phosphorous	44	468.09	276.25	267.08	mg/100 gm
3.	Magnesium	31	329.79	495.53	236.14	mg/100 gm
4.	Calcium	39	414.89	306.7	290.3	mg/100 gm
5.	Iron	0.8	8.51	4.38	5.20	mg/100 gm
6.	Vitamin C	1.24	13.19	25.98	26.24	mg/100 gm

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(0. As referred to Table3-

In the dehydrated cabbage sample, the obtained values of potassium and magnesium in CSD are noticeably higher. The obtained values of phosphorous, calcium and iron are comparable in both CSD and OSD, but much lower than the expected values. In case of vitamin C, the obtained values in CSD and OSD are comparable, but almost two times greater than the expected value. Thus, after dehydration there is a gain in the quantities of potassium, magnesium and vitamin C, but loss in the quantities of phosphorous, calcium and iron and the loss may be due to the higher drying temperature in CSD and the temperature more than the temperature required in OSD.

3.3 CALCULATIONS

Percentage loss in mass (removal of moisture) per unit mass $= [(M_i-M_f)/M_i]\times 100$ %

(over specific period of drying)

Where, M_i=Initial mass of sample before dehydration (kg),

M_f=final mass of sample after dehydration (kg).

Drying rate (time rate of removal of moisture from the sample) = dm/dt (kg/s)

Where, dm=Loss in mass (kg),

dt=Time interval (s).

Drying efficiency of the dryer, $\eta_d = M \times L / (\tau \times I_c \times A \times t) \times 100\%$

Where, M = Loss in mass (kg),

L = Latent heat of vaporization of water (540 kcal / kg) = 2260.4940 kJ/kg

I_c = Insolation incident on the glass cover of the cabinet (W/m^2),

A=Area of the collector, i.e. steel mesh over which sample to be dehydrated is spread (m^2),

t= Time of drying (s), τ = Transmittance of the glass used 85).

3.4 GRAPHS

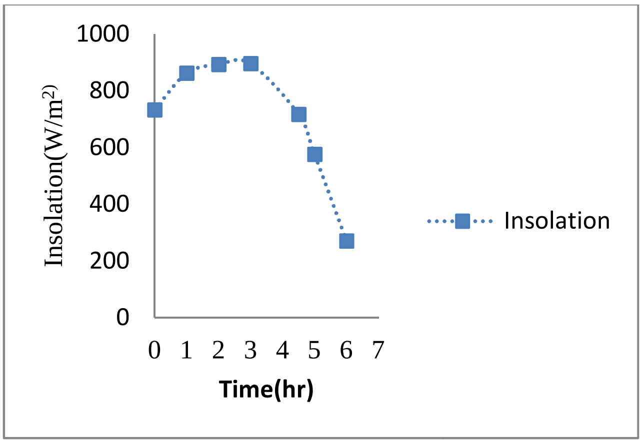

Figure 2: A graph of Surrounding Insolation (W/ m^2) verses Time (hr) as shown in Fig 2.

0(hr) means 10:00 a.m., the starting of observations.

0(hr) means 10:00 a.m. and 6(hr) means 16:00 p.m., the period of observations. During the drying process, the insolation of surrounding was measured over the period of drying. The insolation variation curve in Fig 2 over the specified period of time showed that the maximum and minimum solar insolation values were 896 W/m^2 and 271 W/m^2 at 3(hr), i.e.13:00 p.m. due to the sun being overhead and 6(hr), i.e. at 4:00 p.m. respectively. The surrounding temperature depends upon the insolation incident. The temperature is consistent with the insolation.

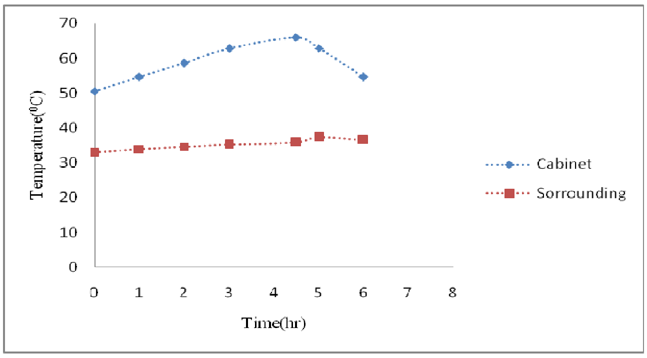

Figure 3: A graph of Temperature (^{0}C) of surrounding and cabinet of the dryer verses Time (hr) is shown in Fig 3.

0(hr) means 10:00 a.m., the starting of observations.

0(hr) means 10:00 a.m. and 6(hr) means 16:00 p.m., the period of observations. The surrounding temperature depends on the insolation falling over the open space. The temperature of cabinet of dryer in consequence depends upon insolation falling on glass cover of the cabinet. The cabinet temperature increases in proportion to the increasing insolation incident, i.e. the variation of temperature is consistent with the variation of insolation incident and it is supported by Hassanian [37].

The plot in Fig 3, shows that the temperature of the dryer at 0(hr), i.e. at 10:00 a.m. was 50.5°C and increased to a maximum at 4.5(hr), i.e. at 14:30 p.m. was 66.0 °C, whereas the ambient temperature on at 0(hr), i.e. at 10:00 a.m. was 33.1°C and maximum after 5(hr), i.e. at 15:00 p.m. was 37.4 °C. Hence the two curves show that there is a considerable temperature difference over the drying periods of CSD & OSD. This highlights the advantage of CSD, the temperature in the cabinet of the dryer being higher, leading to faster moisture removal, i.e. faster drying of the sample as compared with OSD.

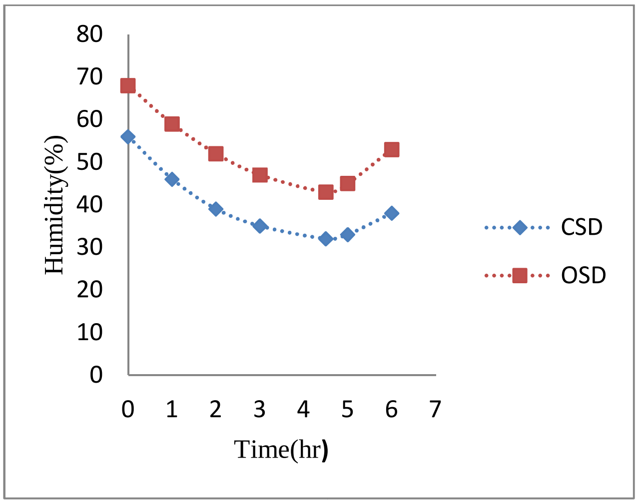

Figure 4: A graph of Humidity of air (%) verses Time (hr) in case of CSD & OSD as shown in Fig 4.

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0(hr) means 10:00 a.m., the starting of observations.
0(hr) means 10:00 a.m. and 6(hr) means 16:00 p.m., the period of observations. The curves in the graph, Fig 4, show the changes in the humidity during day time in both the processes. In the morning and evening time humidity is more and during noon time it is less. The variation in humidity seems to be in accordance with the insolation. The humidity (%) is less in CSD than in OSD as the temperature in CSD is higher than in OSD. This is supported by Serm Janjai [38].

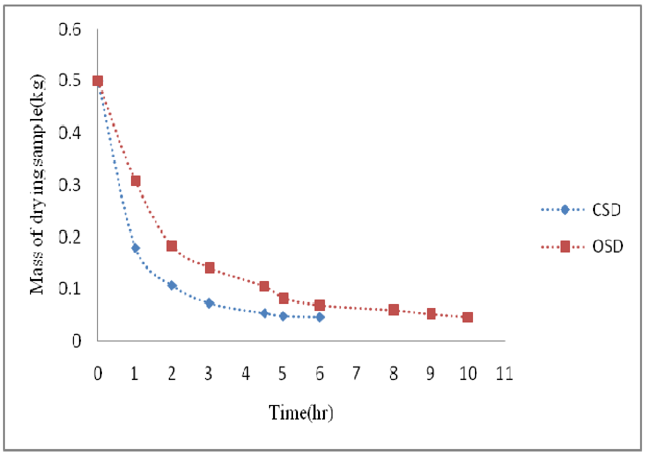

Figure 5: A graph of Mass of drying sample (kg) verses Time (hr) is shown in Fig 5, for both CSD & OSD.

0(hr) means 10:00 a.m. and 8(hr) means 12:00 noon as the starting to note the observations on First & Second day respectively in both cases of CSD & OSD. The observations for OSD started at 10:00 a.m. on the Second day also and the first observation on the Second day was noted after 8(hr) of drying, i.e. at 12:00 noon, in continuation with 6(hr) of drying on the First day.

In CSD the mass of sample after 1(hr) of drying is 0.179 (kg). It decreases further and is 0.047 (kg) after 6 (hr). In OSD, the mass after 1 (hr) of drying is 0.308 (kg). It decreases further and is 0.047 (kg) after 10(hr). So the time taken in OSD is much longer than CSD to achieve the same final level of dehydration.

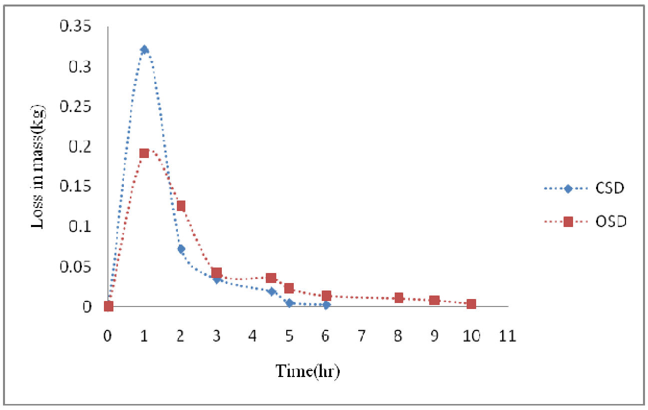

Figure 6: A graph of Loss in mass (kg) of the drying sample verses Time (hr), for both CSD & OSD.

0(hr) means 10:00 a.m. and 8(hr) means 12:00 noon as the starting to note the observations on First & Second day respectively in both cases of CSD & OSD. The observations for OSD started at 10:00 a.m. on the Second day also and the first observation on the Second day was noted after 8(hr) of drying, i.e. at 12:00 noon, in continuation with 6(hr) of drying on the First day.

In CSD, the loss in mass of sample after 1 (hr) of drying is 0.321 (kg). It decreases further and is 0.002 (kg) after 6 (hr). In OSD, the loss in mass after 1 (hr) of drying is 0.192 (kg). It decreases further and is 0.004 (kg) after 10 (hr). This is due to faster drying in CSD than OSD. It is noticeable that after almost 1.5(hr) of drying the loss in mass is slightly more in OSD than in CSD. This is due to more content of moisture still in the sample of OSD than in CSD.

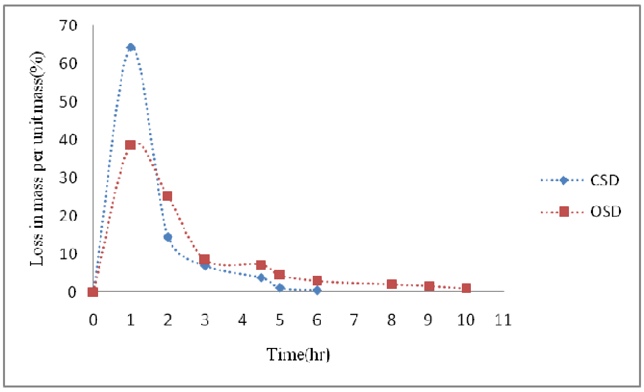

Figure 7: A graph of Loss in mass per unit mass of the drying sample (%) verses Time (hr), for both CSD & OSD.

0(hr) means 10:00 a.m. and 8(hr) means 12:00 noon as the starting to note the observations on First & Second day respectively in both cases of CSD & OSD. The observations for OSD started at 10:00 a.m. on the Second day also and the first observation on the Second day was noted after 8(hr) of drying, i.e. at 12:00 noon, in continuation with 6(hr) of drying on the First day.

The values of loss in mass per unit mass in CSD range from a maximum (64.2%) in the beginning to a minimum (0.4%) at the end, over the period of 6 (hr), whereas in OSD the values range from 38.4% to 0.8%, over the period of 10 (hr). It indicates faster drying of the sample in the dryer. It is noticeable after almost 1.5 (hr) of drying the loss in mass per unit mass (%) is slightly more in OSD than in CSD. This is due to more content of moisture still in the sample of OSD. Moreover, the drying in CSD is much faster than OSD when taken into account the above mentioned drying periods in CSD and OSD, for getting final equal level of dehydration.

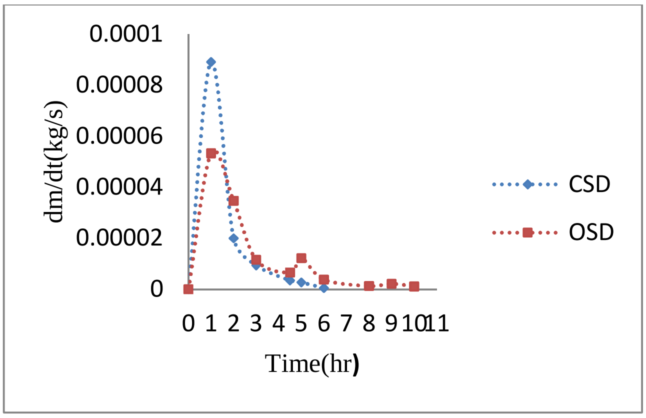

Figure 8: A graph of Drying rate dm/dt (kg/s) verses Time (hr) is shown in Fig 8 for both CSD & OSD.

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0(hr) means 10:00 a.m. and 8(hr) means 12:00 noon as the starting to note the observations on First & Second day respectively in both cases of CSD & OSD. The observations for OSD started at 10:00 a.m. on the Second day also and the first observation on the Second day was noted after 8(hr) of drying, i.e. at 12:00 noon, in continuation with 6(hr) of drying on the First day.

The drying rate dm/dt (kg/s) is maximum in the first hour, decreases further as shown and minimum at the end of the drying processes in CSD & OSD.

In case of dryer the values of dm/dt (kg/s) range from a maximum 0.0000891(kg/s) in the beginning to a minimum 0.0000005 (kg/s) at the end of the process of drying over the period of 6:00 hours. In open sun drying the values range from 0.0000533 (kg/s) to 0.0000011 (kg/s) over the period of 10:00 hours. The curves for CSD & OSD indicate that the drying rates are high in the beginning but in case of CSD the drying rate in the beginning is much higher than that of OSD.

After some period of time the drying rate of OSD becomes slightly more compared to CSD, as much more moisture still remains within the sample in OSD which is yet to be removed from this sample.

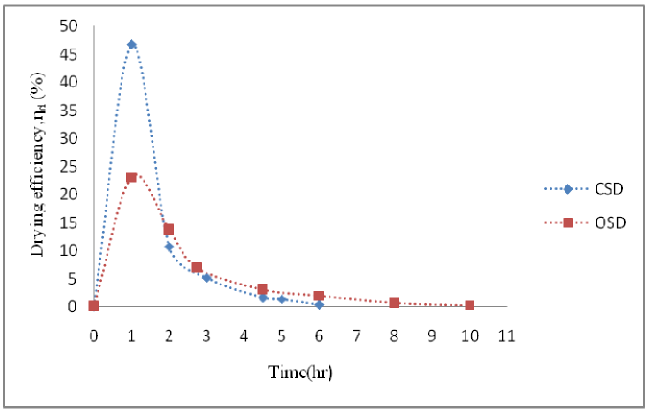

Figure 9: A graph of Drying efficiency, ηd (%) verses Time (hr), for both CSD & OSD.

0(hr) means 10:00 a.m. and 8(hr) means 12:00 noon as the starting to note the observations on First & Second day respectively in both cases of CSD & OSD. The observations for OSD started at 10:00 a.m. on the Second day also and the first observation on the Second day was noted after 8(hr) of drying, i.e. at 12:00 noon, in continuation with 6(hr) of drying on the First day.

The drying efficiency, η_d (%) is maximum in the first hour, decreases further as shown and minimum at the end in the drying processes in CSD & OSD. In case of CSD, the values of drying efficiency, η_d (%) range from a maximum 46.73% to a minimum 0.45% over the period of 6 (hr). In OSD, the values range from 23.17% to 0.25% over the drying period of 10 (hr). The curves show that more is the moisture content, more is the drying efficiency. The drying efficiency in CSD is high in the beginning due to considerable removal of moisture from the sample compared to OSD. Later on after 1:40 hours the drying efficiency in both cases becomes equal (~16%) and then drying efficiency in OSD becomes slightly more than that of CSD. This is because more moisture in OSD sample remains yet to be removed.

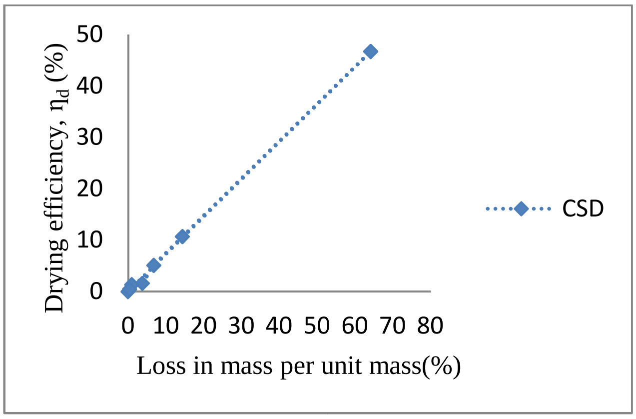

Figure 10: A graph of Drying efficiency, ηd (%) verses Loss in mass per unit mass of drying sample (%) for CSD. [0(hr) means 10:00 a.m., the starting of observations.

0(hr) means 10:00 a.m. and 6(hr) means 16:00 p.m., the period of observations].

The values of loss in mass per unit mass range from a maximum 64.2 (%), after 1 (hr) and to a minimum 0.4 (%), after 6 (hr). Similarly, the values of η_d (%) range from a maximum 46.73 (%), after 1 (hr) and to a minimum 0.45 (%), after 6 (hr). As time increases both the parameters go on decreasing in proportion and hence we get a straight line. It means that η_d (%) varies in proportion with loss in mass per unit mass (%). η_d (%) is dependent on loss in mass per unit mass (%).

It is probable to get the similar graph in case of OSD also.

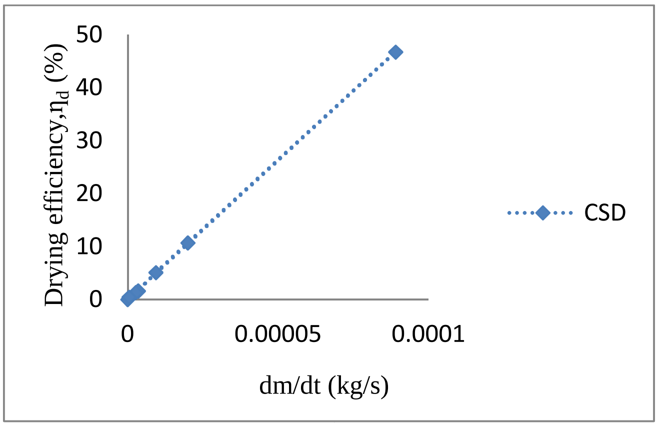

Figure 11: A graph of Drying efficiency, ηd (%) verses Drying rate, dm/dt (kg/s) for the drying sample in CSD.

[0(hr) means 10:00 a.m., the starting of observations.

0(hr) means 10:00 a.m. and 6(hr) means 16:00 p.m., the period of observations].

The values of dm/dt (kg/s) range from a maximum 0.0000891 (kg/s), after 1 (hr) and to a minimum 0.0000005 (kg/s), after 6 (hr). Similarly, the values of η_d (%) range from a maximum 46.73 (%) after 1 (hr) and to a minimum 0.45 (%), after 6 (hr). As the time of drying increases both the parameters go on decreasing in proportion and hence we get a straight line. It means that η_d (%) varies in proportion with the drying rate dm/dt (kg/s). η_d (%) is dependent on dm/dt (kg/s).

It is probable to get the similar graph in case of OSD also.

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IV. CONCLUSIONS

- In open sun drying the food products can be contaminated with the dust, raining, fungus, flies, rodents etc. Since ambient temperature depends on the solar insolation incident, there is no control over the drying temperature and in consequence no proper drying of the sample. The quality of the dried product is poor. Hence open sun drying should be avoided.
- The cabinet solar dryer can be fabricated indigenously. It is easy to handle. Dehydration of the food product using dryer is safe, free from contamination and pollution.
- Solar energy required for drying is renewable, abundant, available at free of cost, clean, pollution free and lasting for millions of years in future. It is the genuine source of energy.
- The dehydration period of Cabinet Solar Dryer (CSD) is 6:00 hrs and that of Open Sun Drying (OSD) is 10:00 hrs. It means that drying of the sample is much faster in CSD than in OSD. The curves in the graphs of Figure 5 to Figure 9 indicate that they are consistent with much faster drying and proper moisture removal from the sample in CSD as compared to OSD.
- The curves in the graph, Figure 9 show that moisture content is a prominent factor in the determination of drying efficiency. The drying efficiency of CSD is more than that of OSD.
- The straight lines in the graphs of Figure 10 and Figure 11, show that the drying efficiency, η_d (%) is dependent on the loss of mass per unit mass (%) and the drying rate dm/dt (kg/s). Since loss in mass per unit mass (%) and drying rate dm/dt (kg/s) depend on the moisture content of the drying sample, η_d (%) in consequence depends on the moisture content of the sample, as made clear by the curves in the graph of Figure 9.
- From Table 1, the results show that the sensory parameter like flavour, an important aspect, is retained as its natural characteristic flavour of cabbage after dehydration in CSD but not in OSD. There is a change in texture, but colour and taste are the same in both CSD and OSD.
- From Table2, it is seen that the obtained values in the analysis of macronutrients like energy value, protein, carbohydrate and fat of the dehydrated samples are comparable both in CSD and OSD.
- The obtained values of dried samples in CSD and OSD of the above macronutrients (except protein) are considerably higher than the expected values. The obtained value of dietary fibre is somewhat less than the expected value. The decrease in obtained values of protein (broken peptide linkage) and dietary fibre compared to the expected values are less due to their loss during dehydration.
- From Table 3, it is clear that after dehydration there is a gain in the quantities of micronutrients like potassium, magnesium and vitamin C, but loss in the quantities of phosphorous, calcium and iron and the loss may be due to higher drying temperature in CSD and the temperature more than the temperature required in OSD.
- In general, the contents of sensory parameters, macronutrients and micronutrients are retained effectively after dehydration of the food product in the cabinet solar dryer in comparison with the open sun drying. This is due to the safe dehydration over the specific period and at the controlled temperature in CSD. The obtained values are more in CSD than in OSD. Also obtained values in CSD are remarkably higher compared to the expected values. The nutrients are concentrated in a small volume of the dehydrated sample. So the dehydrated food product is a concentrated source of energy. Also the shelf life of dried product increases and we can store it for longer time. Taking into account all merits of dehydration, the role of the solar dryer is prominent and exclusive in the process of dehydration.
- In all, it is necessary now-a-days to utilize solar energy effectively and meaningfully wherever possible, like the dehydration of the food product to get the enriched nutrious food with the increased shelf life, i.e. such can be used for longer time. The dehydrated vegetables and food products seems to be the need in future and it can lead to the dry food technology at large.

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