International Standard Serial Number (ISSN): 2249-6807

*International Journal of Institutional Pharmacy and Life Sciences 4(2): March-April 2014*

INTERNATIONAL JOURNAL OF INSTITUTIONAL PHARMACY AND LIFE SCIENCES

**Pharmaceutical Sciences** **Research Article……!!!**

Received: 30-11-2013; Revised; Accepted: 21-04-2014

# EFFECT OF DRYING METHODS ON CHEMICAL COMPOSITION OF *COSTUS SPECIOSUS* (KOEN.) SM.

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**Keywords:**

Diosgenin, Drying methods

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## ABSTRACT

Strong and sustained demand of medicinal plants in India and international market provides the necessary stimulus for cultivation and income opportunities to the rural population if it's harvesting and processing is managed scientifically. Conventional air/sun drying is the most frequently used dehydration operation of tuberous plant material. However, several methods can be applied for the drying of produce i.e. sun drying, shade drying, oven drying, hot air drying, microwave drying and freeze drying. The paper reports the effects of drying methods on quality of tuberous plant, *Costus specious* (koen) Sm. ( Keokand) which is a potential source of diosgenin, a precursor for the chemical synthesis of steroidal and also a source of polysaccharides, protein and essential oil. These chemical compounds are affected in both quality and quantity by the production as well as processing practices employed by the growers. Generally sun drying and shade drying are the traditional methods which are time consuming (that may not be applicable throughout the year) and which also alters the quality of produce. The data has been gathered on chemical analysis i.e. diosgenin, starch, reducing suger, protein and essential oil of Keokand rhizomes dried by different methods, in view of better quality of the produce and saving time with minimum input It is revealed that it would be worthwhile to adopt oven drying at 40-60$^{o}$C, in order increase the quality and therefore yield of the processed produce. Diosgenin content was obtained maximun in fresh samples and among dried samples, in oven drying (40$^{o}$C) giving maximum yield in comparison to other methods like sun drying, shade drying and hot air drying at 40$^{o}$C, 60$^{o}$C and 80$^{o}$C temperature. Similarly concentration of other bio chemicals were also found to be affected by drying methods.

## INTRODUCTION

India's forests are a rich depository of a multitude of herbs, shrubs and trees that yield a variety of wood and non-wood products for domestic consumption as well as trade. Herbs and shrubs obtained from vegetable kingdom comprising of about 2000 raw materials which are being utilized in the manufacture of various pharmacal preparations like Homeopathic, Ayurvedic, Unani and Siddha drugs. At present about 400 varieties of crude drugs and herbs are being exported from India. Strong and sustained demand of medicinal plants in India and international market provides the necessary stimulus for cultivation and income opportunities to the rural population , if it's harvesting and processing is managed scientifically.

Due to the increasing demand and awareness regarding cultivation of cash crops, their value in market depends on quality of processed product that keeps more of their original characteristics. During the past decade, much attention was paid on the quality of dehydrated/dried produce. The specific drying method as well as physico-chemical changes that occur during drying seems to be affect the quality of dehydrated products.

The increasing need for producing efficiently high quality and convenient products at a competitive cost has led to the employment of several drying methods in practice. Presently producers are unable to get beneficial prize due to the lack of knowledge of proper processing -drying methods. Conventional air/sun drying is the most frequently used dehydration operation of tuberous plant material. However, several methods can be applied for the drying of produce i.e. sun drying, shade drying, oven drying, hot air drying, microwave drying and freeze drying. The rate and temperature of drying have a substantial effect on the texture & chemical quality of plants. In general, rapid drying and high temperature causes greater changes than do moderate rates of drying and lower temperatures.

As water is removed during dehydration, solutes move from the interior of the food to the surface. Subsequent evaporation of water causes concentration of solutes at the surface. Reaction occurring during drying can result in quality losses, particularly nutrient losses and other deterioration caused by browning reactions. The plant *Costus speciosus* (koen) Sm. belongs to family Zingiberaceae, is a common plant with a tuberous rhizome, widely distributed throughout India upto an altitude of 4000 ft. In its natural habitat it grows in moist, partially shady localities. In most of the places especially in plains, the plant occurs as weed in orchards, boundaries of cultivated fields, in the depressions along roads and forest margins situated close to habitation.

It is a potential source of diosgenin, a precursor for the chemical synthesis of steroidal drugs and is tremendously important to the pharmaceutical industry. It is also a source of polysaccharides, protein and essential oil. These chemical compounds are affected in both quality and quantity by the production as well as processing practices employed by the growers. In processing of tuberous corps, drying play an important role as it affects the quantity of chemicals severely, in comparison to fresh products. *C.speciosus* is under cultivation in different parts of India due to the presence of starch and diosgenin in rhizomes and other parts of the plant. Propagation is usually by stem cutting. Its rhizome is edible and used after cooking. It is mucilaginous, rich in starch with high fiber content, feebly astringent and has no aroma. In some parts of India it is cooked in syrup and made into a preserve.

The whole plant has medicinal properties. The rhizomes are bitter, astringent, acrid, cooling, aphrodisiac, purgative, anthelmintic, depurative, febrifuge, expectorant and useful in burning sensation, constipation, leprosy, worm infection, skin diseases, fever, asthma, bronchitis, inflammations and anemia. Tripathi and Tripathi (1999) studied the nutritional potential i.e. carbohydrates,protein and minerals of rhizomes of *C. speciosus* at the different vegetative stages. Diosgenin serves in the pharmaceutical industry as starting material for the production of corticosteriod sexual hormone preparation as well as for the production of anabolic agents and cardio glycosides. This has made the plant in India and other countries a valuable raw material source for pharmaceutical industry (Zenk, 1978; Chakravarti, 1979; Asolkar et al, 1979; Gupta et al. 1981). It accounts for about 50% of the total steroidal drugs. A wide range of variation in the diosgenin content was observed in the rhizomes and other parts of *C.speciosus* (Sarin *et al*., 1976). They reported that analysis of a large number of rhizome samples collected from various localities during different months revealed a lot of variation in diosgenin content from plant to plant as well as at different periods of harvest during the full bloom period in the month of July and August. The paper deals with the effect of traditional drying methods i.e. sun-drying and other simple affordable drying methods like Oven drying and hot air drying at different temperatures on phyto-chemicals.

**MATERIAL AND METHODS**

*C.speciosus* rhizomes were harvested/collected in the month of March from Non Wood Forest Product Nursery, TFRI, Jabalpur. Average sized rhizomes-were randomly selected for processing. The selected rhizomes were weighed before peeling and thoroughly washed by scrubbing with the knife and cutting in slices using a manual slicer. Rhizomes were reserved for immediate chemical analysis.

For drying only traditional methods i.e. sun drying, shade drying, hot air drying and oven drying were used in the present study as poor grower at an affordable investment can utilize these method. 250gms of peeled and sliced material was sun dried and ground in a mixer and weighed. 150gm of peeled and sliced material was dried using a hot air blower at 40$^{O}$C, 60$^{O}$C, 80$^{O}$C and ground in a mixer and weighed. 150 gm of each peeled and sliced material was oven dried at 40$^{O}$C, 60$^{O}$C, 80$^{O}$C and ground in a mixer and weighed. Moisture content was determined by drying 15 gm of sample in hot air oven at 110$^{o}$ C, till constant weight was achieved.

Diosgenin content was estimated by method reported by Sarin *et al*.,1981. Finely powered dried material (1gm) was hydrolyzed with 3N HCL and kept on a magnetic stirrer hot plate for 2 hrs. The temperature was maintained between 90-96$^{O}$C. The mixture was allowed to cool and the aqueous phase was taken in separating funnel extracted with 25ml of Hexane twice and combined organic phase was washed with 15ml sodium bicarbonate solution and subsequently with distilled water and the volume made upto 100ml with Hexane. 5ml of aliquots of this extract was taken and solvent was removed and color was developed by adding 5ml of (perchloric acid) $HClO_4$ and 0.1ml of antimony trichloride $SbCl_3$ and the absorbance measured at 486nm against the reagent blank.25 mg pure diosgenin was dissolved in methanol (250 ml) for stock solution. 10, 20, 40, 60, 80 and 100 ug solutions were prepared and developed colour as in samples. Measured absorbance at 486 nm against reagent blank. The concentration of diosgenin was calculated with the help of standard curve.

Detection of Diosgenin - SbCl3 solution (24% in 70% $HClO_4$)

Solvent System - Chloroform: Petroleum ether in 40:10 ratio.

Glass plates coated with silica 'G' were activated at 100$^{O}$C for 30min. The acid hydrolyzed plant material (acid free) were applied 1 cm above the edge of the plates and developed in a solvent mixture of chloroform and petroleum ether (4:1). The authentic diosgenin standard was run as reference. Starch concentration was determined using Anthrone reagent method (Hodge and Hofreiter, 1962).

Protein concentration in the samples was determined by Lowry's method.

Reducing sugar concentration in the samples was determined by Dinitro-salicylic acid method (Sadasivam & Manikam, 1992).

Essential oil was extracted with the help of Clevenger apparatus and estimated.

**Statistical Analysis :** Statistical analysis was done with help of Statistical Software SPSS-14.

**RESULTS AND DISCUSSION**

The fresh rhizome contained 0.86% diosgenin, 31.43% starch, reducing sugar 22.24%, protein 20.17% and 0.83% essential oil. Table –1 reveals that *C. speciosus* is moderately rich source of carbohydrates, protein and diosgenin.Drying of fresh rhizomes at 105$^{o}$C till constant temperature revealed the presence of 89.66% moisture or water contents.

**Table -1 Biochemicals in fresh rhizomes of *C. speciosus*.**

| Parameters analyzed | Percentage % |
|---|---|
| Moisture | 89.66 |
| Diosgenin | 0.86 |
| Starch | 31.43 |
| Reducing sugars | 22.24 |
| Protein | 20.17 |
| Essential oil | 0.83 |

Values are the mean of 3 replication

Significant variation was observed due to different drying methods. Drying resulted in several substantial changes in tuberous composition. In comparison with freshly harvested tubers, drying increased dried matter content through water evaporation, soluble solids and total sugars. Diosgenin, starch, reducing sugar, protein and essential oil levels are important parameters that represent the nutritional value as well as pharmaceutical importance of *C. speciosus*.The effect of different methods of drying on diosgenin contents are presented in Table-2 and Figure 1, 2 & 3.

**Table-2 Effect of different drying methods on chemicals of *C. speciosus* rhizomes.**

| Drying method | | Diosgenin | Starch% | Reducing sugar % | Protein% | Essential oil % |
|---|---|---|---|---|---|---|
| Sun drying | | 0.72 | 30.29 | 19.28 | 19.57 | 0.69 |
| Shade drying | | 0.70 | 29.28 | 18.57 | 18.58 | 0.78 |
| Oven drying | 40$^{o}$c | 0.75 | 32.03 | 19.72 | 22.18 | 0.76 |
| | 60$^{o}$c | 0.71 | 30.05 | 16.06 | 21.43 | 0.70 |
| | 80$^{o}$c | 0.51 | 28.00 | 22.54 | 16.16 | 0.61 |
| Hot air drying | 40$^{o}$c | 0.64 | 32.22 | 18.12 | 21.78 | 0.71 |
| | 60$^{o}$c | 0.63 | 31.32 | 19.70 | 20.28 | 0.70 |
| | 80$^{o}$c | 0.52 | 28.55 | 21.07 | 18.81 | 0.60 |
| CD(P=0.01) | | 0.365 | 1.9806 | 1.3299 | 0.02815 | 0.03707 |

**Values are the mean of 3 replication**

**Figure-1**

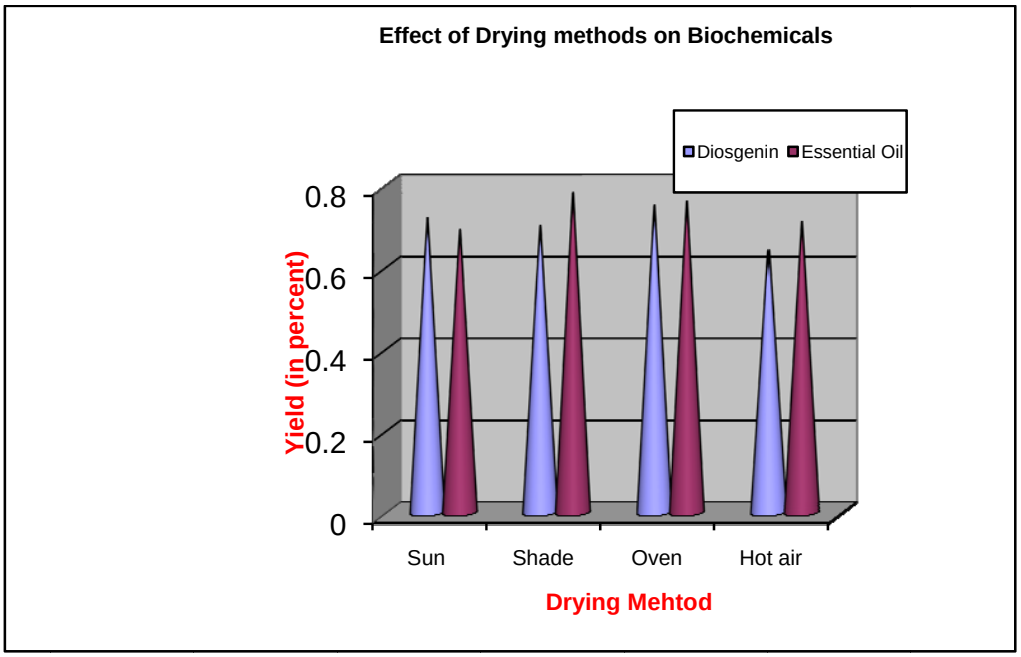



**Figure-2**

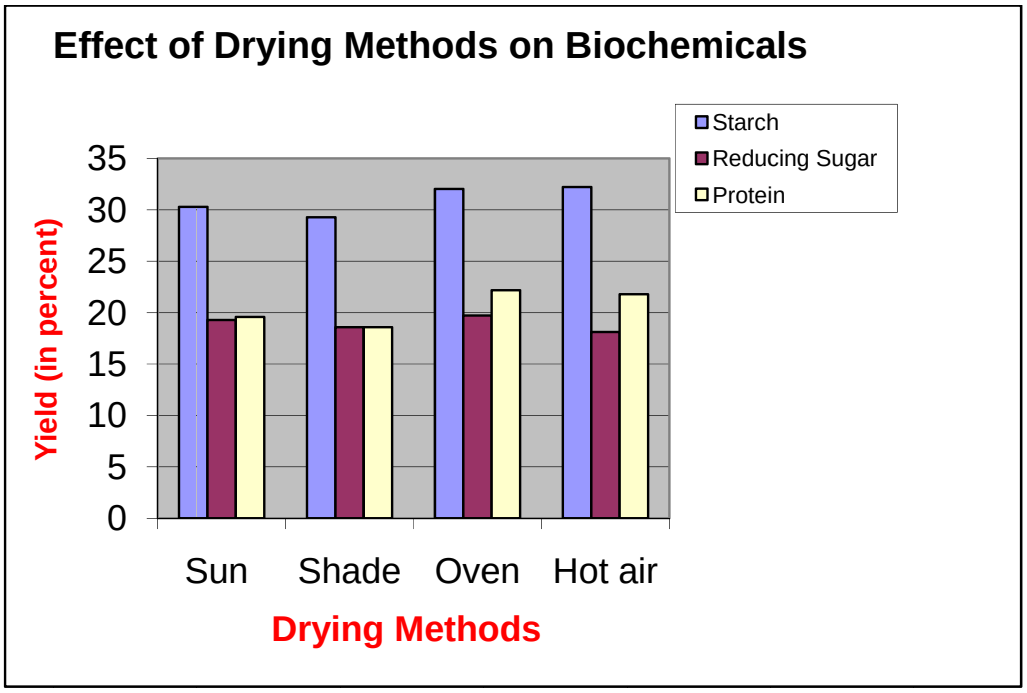
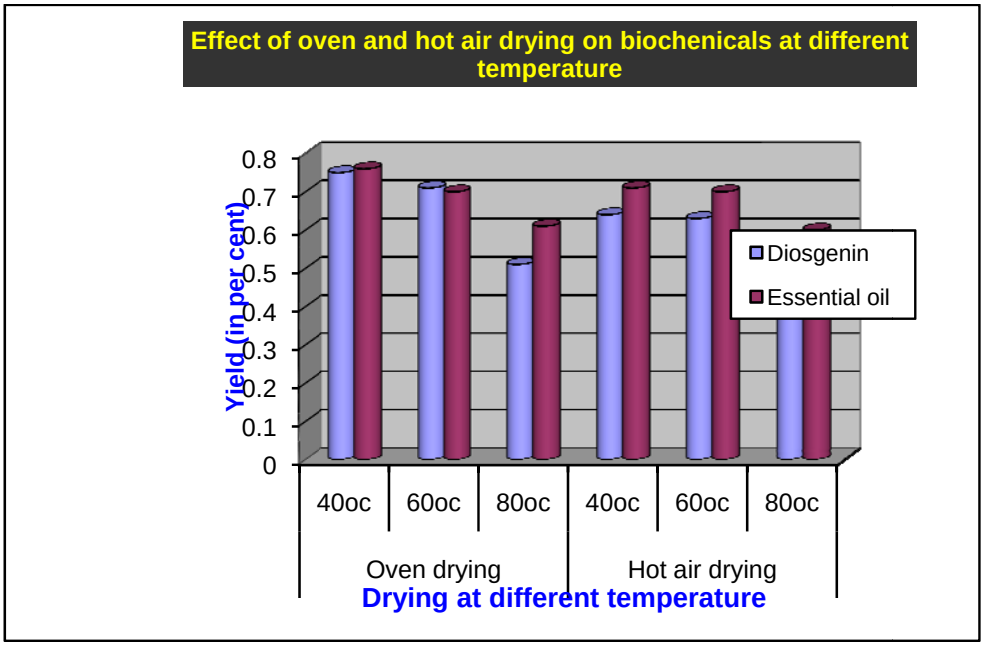


**Figure-3**




Diosgenin concentration was estimated in the samples dried under different methods. Diosgenin concentration i.e. 0.72% was recorded in sun-dried samples. Having temperature range between $40^0$C to $44^0$C, during the month of April. Significant variation (P=0.01) was observed within the different treatments. Oven drying at $40^0$C resulted in 0.75% diosgenin content followed by $60^0$C (0.71% and $80^0$C (0.51%), respectively. In hot air drying 0.64, 0.63 and 0.52% was obtained at 40-60 and $80^0$C, respectively. However, no significant difference in diosgenin concentration was observed in sun dried and shade dried samples. The concentration of diosgenin decreased in oven dried and hot air dried samples at 80ºC. The results were also supported by the findings of Schooley (1998), studied the effect of drying temperature on ginsenoside. Since post harvest handling of *C. speciosus* and other rhizomatous crops could affect the quality, drying method and duration had significant effects on moisture content. However, at higher temperature sample dried in shorter time period, generally resulted in further losses in chemical contents (Krokida, 2000). Drying resulted in several substantial changes in rhizomes. The water must have enhanced the polysaccharide and pectin degrading enzymes that alter the integrity of cell membranes; these changes most likely resulted in loss of some soluble causing a decrease in yield. Drying method had significant (P=0.01) effect on starch percentage with hot air drying giving the highest starch content (32.22%). No significant variation was observed in sun drying, shade drying, oven drying ($60^0$C) and hot air drying $80^0$C methods.

Similarly, reducing sugar content (22.54%) was found to be increased as temperature increased in the oven drying at $80^0$C . This might be due to the hydrolysis of di or polysaccharides sugars as the temperature increased. Schooley (1998), also reported the effect of processing practices i.e. effect of different drying temperatures on starch and sugar contents of Ginseng roots, suggested that starch hydrolysis occurs at temperatures above $32^0$C during forced air drying.

Significant variation (P=0.01) was observed in quantity of protein and maximum protein concentration 22.18% & 21.43% was obtained at $40^0$C to $60^0$C in samples of *C.speciosus* followed by hot air dried samples at $40^0$C minimum concentration of protein (16.06%) was estimated in oven dried sample at 80ºC. It was revealed that quantity of protein is very much affected due to high temperature in sun drying (19.57%) and shade dried samples (18.58%). These values are in agreement with earlier studied carried out on the effect of drying temperature on fodder quality and tannin content of *Calliandra calothyrsus* Meissner (Stewart et al. 2000). The study suggested that careful air drying without excessive heating may not reduce the nutritive value i.e. protein of *C. calothyrsus* . Maximum essential oil concentration (0.78%) was observed in shade-dried samples while 0.69% in sun dried samples. Shade dried samples possessed significantly high percentage of oil in comparison to sun-dried samples.

Temperature of drying also affects the quantity of oil concentration, which decreased significantly at $80^0$C in oven drying and shade drying treatment. This might be due to the reasons that volatile organic compounds/terpenes are responsible for aroma and flavour which have boiling points lower then water. Volatiles, which have a high relative volatility and diffusivity, are lost at an early in drying. The present results also confirmed the finding of Tonzibo *et. al*., (1998). They found effect of drying on essential oil composition and yield in *Eucalyptus citriodora* leaves.

From the drying method, no discoloration was observed in any drying method except slight browning in shade drying. It was found that drying time was reduced considerably in oven and hot air drying in comparison to open sun drying and shade drying. Open sun drying took 3 days while controlled oven drying and hot air drying took only 2 to 3½ hrs. The duration and temperature of drying had a substantial effect on quality of the produce / rhizomes also. If we consider the time taken in each method, maximum time (5 days) was taken when *C. speciosus* rhizomes was dried in shade while in sun drying it took 3 days (in the month of April, when temperature ranged from 40-44ºC and shade temperature ranged from 30- $35^0$C).

## CONCLUSION

Generally sun drying and shade drying are the traditional methods which are time consuming (that may not be applicable throughout the year) and which also alters the quality of produce. In view of better quality of the produce and saving time with minimum input, it would be worthwhile to adopt oven drying at 40-60$^0$C, in order to increase the quality and therefore yield of the processed produce. Maximum yield of diosgenin in *C. speciosus* rhizomes was obtained in fresh samples and among dried samples in oven drying (40$^0$C) giving maximum yield in comparison to other methods like sun drying, shade drying and hot air drying at 40$^o$C, 60$^o$C and 80$^o$C temperatures.

**ACKNOWLEDGEMENT:** Thanks are due to ICFRE, D.Dun for the financial support.

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