



## Research Paper

### Effect of drying methods on chemical composition of *Costus speciosus* (Koen.) Sm.

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**Abstract:** The data has been gathered on chemical analysis i.e. diosgenin, starch, reducing sugar, 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. The fresh rhizome contained 0.86% diosgenin, 31.43% starch, reducing sugar 22.24%, protein 20.17% and 0.83% essential oil. Diosgenin concentration i.e. 0.72% was recorded in sun-dried samples. Having temperature range between 40<sup>0</sup>C to 44<sup>0</sup>C, during the month of April. Significant variation ( $p < 0.01$ ) was observed within the different treatments. Oven drying at 40<sup>0</sup>C resulted in 0.75% diosgenin content followed by 60<sup>0</sup>C (0.71% and 80<sup>0</sup>C (0.51%), respectively. Drying method had significant ( $p < 0.01$ ) effect on starch percentage with hot air drying giving the highest starch content (32.22%). Similarly, reducing sugar content (22.54%) was found to be increased as temperature increased in the oven drying at 80<sup>0</sup>C.

**Keywords:** Diosgenin, essential oil, reducing sugar, drying methods.

**Abbreviations:** Tropical Forest Research Institute (TFRI),

## 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.

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. 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. *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. 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.

A wide range of variation in the diosgenin content was observed in the rhizomes and other parts of *C. speciosus* (Sarin *et. al.*, 1981). 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 reports the effects of drying methods on quality of tuberous plant, *Costus speciosus* (koen) Sm. (Keokand)

## MATERIAL AND METHODS

*C. speciosus* rhizomes were harvested/collected in the month of March from Non Wood Forest Product Nursery, Tropical Forest Research Institute, 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 this method. 250 gms of peeled and sliced material was sun dried and ground in a mixer and weighed. 150 gm of peeled and sliced material was dried using a hot air blower at 40°C, 60°C, 80°C and ground in a mixer and weighed. 150 gm of each peeled and sliced material was oven dried at 40°C, 60°C, 80°C and ground in a mixer and weighed. Moisture content was determined by drying 15 gm of sample in hot air oven at 110°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°C. The mixture was allowed to cool and the aqueous phase was taken in separating funnel extracted with 25 ml of Hexane twice and combined organic phase was washed with 15 ml sodium bicarbonate solution and subsequently with distilled water and the volume made upto 100 ml with Hexane. 5ml of aliquots of this extract was taken and solvent was removed and color was developed by adding 5 ml of (perchloric acid) HClO<sub>4</sub> and 0.1ml of antimony trichloride SbCl<sub>3</sub> 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. 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 and Manikam, 1992). Essential oil was extracted with the help of Clevenger apparatus and estimated.

**Statistical Analysis:** Statistical analysis was done with the 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°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,

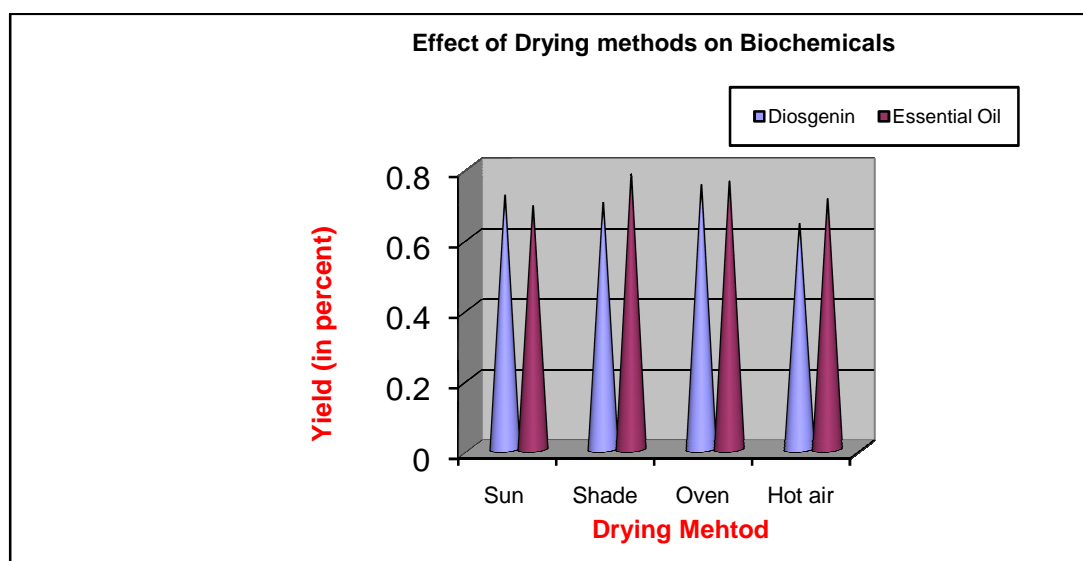
starch, reducing sugar, protein and essential oil levels are important parameters that represent the nutritional value as well as pharmaceutical importance of *C. speciosus*. The effect of different methods of drying on diosgenin

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

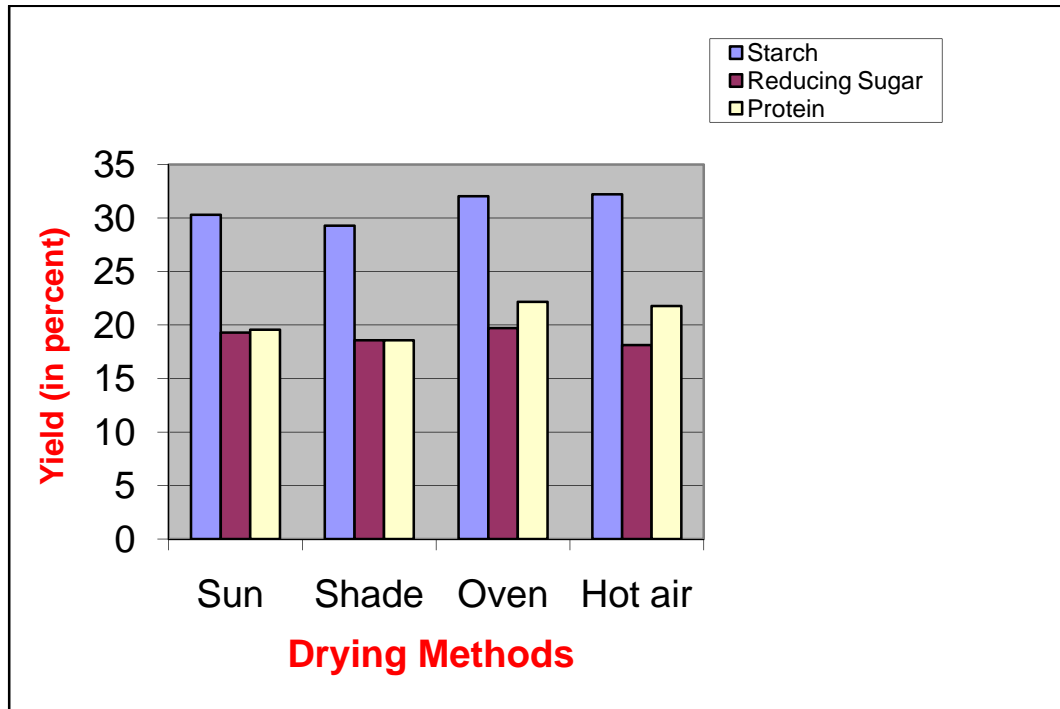
<i>Drying method</i>		Diosgenin	Starch%	Reducing sugar %	Protein%	Essential oil %
Sun drying		0.72	30.29	19.28	19.57	0.69
Shade drying		0.70	29.28	18.57	18.58	0.78
Oven drying	40 <sup>o</sup> c	0.75	32.03	19.72	22.18	0.76
	60 <sup>o</sup> c	0.71	30.05	16.06	21.43	0.70
	80 <sup>o</sup> c	0.51	28.00	22.54	16.16	0.61
Hot air drying	40 <sup>o</sup> c	0.64	32.22	18.12	21.78	0.71
	60 <sup>o</sup> c	0.63	31.32	19.70	20.28	0.70
	80 <sup>o</sup> 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

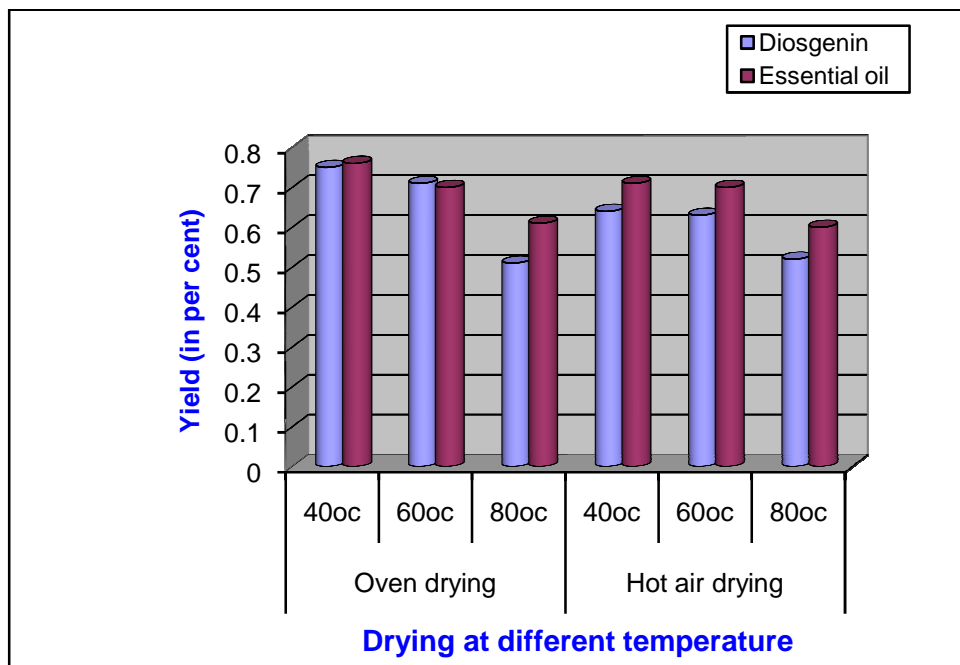
**Figure-1 Effect of Drying methods on Biochemicals**



**Figure-2. Effect of drying methods on Biochemicals**



**Figure-3. Effect of oven and hot air drying on biochemical at different temperature**



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<sup>0</sup>C to 44<sup>0</sup>C, during the month of April. Significant variation ( $p < 0.01$ ) was observed within the different treatments. Oven drying at 40<sup>0</sup>C resulted in 0.75% diosgenin content followed by 60<sup>0</sup>C (0.71% and 80<sup>0</sup>C (0.51%), respectively. In hot air drying 0.64, 0.63 and 0.52% was obtained at 40-60 and 80<sup>0</sup>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 80<sup>0</sup>C. 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<sup>0</sup>C) and hot air drying 80<sup>0</sup>C methods. Similarly, reducing sugar content (22.54%) was found to be increased as temperature increased in the oven drying at 80<sup>0</sup>C. This might be due to the hydrolysis of di or polysaccharides sugars as the temperature increased.

Significant variation ( $p < 0.01$ ) was observed in quantity of protein and maximum protein concentration 22.18% & 21.43% was obtained at 40<sup>0</sup>C to 60<sup>0</sup>C in

samples of *C. speciosus* followed by hot air dried samples at 40<sup>0</sup>C minimum concentration of protein (16.06%) was estimated in oven dried sample at 80<sup>0</sup>C. 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<sup>0</sup>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 than 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.*, (1988). 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 40-44°C and shade temperature ranged from 30- 35°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°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°C) giving maximum yield in comparison to other methods like sun drying, shade drying and hot air drying at 40°C, 60°C and 80°C temperatures.

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