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Studies on Standardization of Coconut (*Cocos nucifera* L.) Milk Powder by Spray Drying"

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ABSTRACT

The coconut milk powder prepared from Coconut *(Cocos nucifera L.)* fruits with 10, 15, 20, 25 per cent maltodextrin and 5 per cent skim milk concentration and stored for storage period of 1 month. During storage the powder was analyzed for moisture, water activity, protein and fat and organoleptic rating in three replications. The data was analyzed using factorial-completely randomized design. An increasing trend in moisture and water activity and decreasing trend in protein and fat content with advancement of storage period was observed. Powder prepared with the recipe of 15 per cent maltodextrin, 5 per cent skim milk was found to be best recipe with respect to organoleptic qualities like colour, flavour and texture and found acceptable upto one month of storage.

Key words *Coconut milk, powder, Storage, Organoleptic quality*

The coconut fruit is the member of the family Arecaceae (palm family). The fruit mainly found throughout the tropic and subtropic area. The fruit mainly found throughout the tropic and subtropic area. In India, coconut is cultivated in 18 states and 3 union territories in an area of 1.9 million hactares. The annual production is estimated at 10840 million nuts (Anon., 2011). India is the second largest producer of coconut in the world accounting for 25.75 per cent in production and 15.58 per cent in area. India's production of coconut is 15729.75 million nuts/ha and productivity is 5718 nuts/ha. In Maharashtra, the production of coconut is 175 million nuts/ha and productivity is 8338 nuts/ha (2008-2009) (Anon., 2009).

In The coconut palm (*Cocos nucifera L.)* is cultivated for its multiple utilities mainly for its nutritional and medicinal value. The various products of coconut include tender coconut water, copra, coconut oil, raw kernel, coconut cake, coconut toddy, coconut shell and wood based product, coconut leaves, coir pith *etc*. It's all parts are used in someway or another in a daily life of people in the traditional coconut growing areas. Therefore, eulogised as "Kalpavriksha" (the all giving tree) in Indian classics. (Marar, *et al.* 1957)

Coconut is a unique source of various natural products for the development of medicines against various diseases and also for the development of industrial products. Coconut milk is a rich source of manganese and phosphorus. Each cup of coconut milk supplies the body with nearly a quarter of daily value of iron.

Following are the nutritional values present in 100 grams of fresh coconut milk.

- Calories – 254 kcal
- Proteins – 3.3g
- Fat – 29.69g
- Carbohydrates – 15.23g
- Dietary fiber – 9.0g
- Sugar – 6.23g
- Calcium – 14mg
- Iron – 2.43mg
- Magnesium – 32.0mg
- Phosphorus – 113mg
- Potassium – 356mg
- Sodium – 20.0mg
- Zinc – 1.10mg
- Copper – 0.4mg
- Manganese – 1.5mg

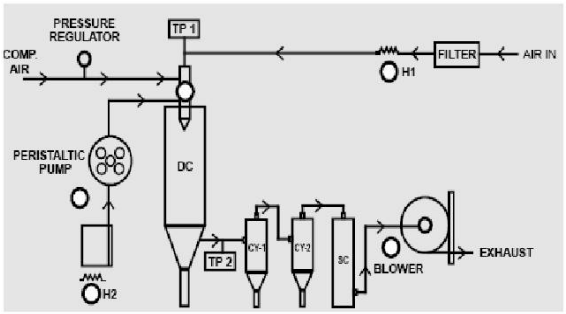
USDA, (2004)

MATERIAL AND METHODS

Uniformly matured coconuts were selected for manual extraction of milk from coconut's white flesh (solid endosperm) by means of muslin cloth. The coconut milk powder was prepared as per the methodology suggested by MOHD ALI HASSAN (1985). Coconuts were cut into two pieces and white flesh is grated. Then milk was extracted from

flesh by muslin cloth. Protein and fat of milk was analyzed immediately after extraction of milk. After addition of maltodextrin and skim milk homogenised thoroughly by using mixer grinder as a stirrer and was used for preparation of powder.

Coconut milk powder was prepared with 10, 15, 20 and 25 per cent maltodextrin concentrations with 5 per cent skim milk. The machine is used for manufacturing coconut milk powder is spray dryer (SPD-D-111) from Technosearch laboratory (Plate 2) was employed for spray drying process as shown in following diagram.



P & I Diagram of Spray drying

Sr. No.	Features	Specifications
1.	Inlet temperature	190^0C
3.	Outlet temperature	85-88^0C
4.	Aspirator speed	45 m^3/hr
5.	Feed pump	2.5 ml/min
12.	Vacuum	-90 to -120 mmwc
13.	Pressure	1 kg/cm^2

Immediately after spray drying the powder was packed in the multilayer aluminium pouches for further physical, chemical and sensory evaluation. Then the nectar was stored for one month and analyzed for the different quality parameters. The colour of carambola nectar was measured using colour reader (make Konica Minolta, Japan) and expressed as L*, a*, b* values. The moisture content of coconut milk powder was determined using a Contech moisture analyser (model CA-123) at 100^0C.

Water activity was determined by using a Dew point water activity meter (AQUALAB series 4TE) at 25^0C.Protein was determined by Micro-Kjeldahl method and fat content in powder was determined by Soxhlet apparator. It was also evaluated during storage for sensory attributes like colour, flavour, taste and overall acceptability by panel of 5 judges on 9 point hedonic scale (Amerine *et al*., 1975). The obtained data were statically analyzed by using factorial completely randomized design (FCRD) described by Panse and Sukhatme (1985).

Table 1. Chemical composition of fresh coconut milk

Sr. No.	Particulars	Mean*
1	Protein (%)	**6.0**
2	Fat (%)	**36.2**

Selection of coconut fruit
↓
Dehusking
↓
Grating
↓
Extraction of milk
↓
Additives
(Maltodextrin & skim milk)
↓
Homogeniser
↓
Spray dryer
↓
Coconut milk powder
↓
Packaging
↓
Storage

Fig. A. Flow chart for preparation of coconut milk powder

RESULTS AND DISCUSSION

The changes in chemical composition viz. Moisture, Water activity, Protein, fat and organoleptic rating of coconut milk powder during storage are presented here under. Coconut milk used in the preparation of powder contained Protein 6 and fat 36.2 per cent which is presented in Table 1. The changes in physico-chemical composition of coconut milk powder during storage are presented in Table 2, 3, 4, and 5 and fig. 1,2,3,4 and 5.

Studies on the qualitative changes during storage of coconut milk powder revealed that

Table 2. Changes in moisture (%) of coconut milk powder during storage

Treatments*	Moisture (%)		
	Storage period (days)		Mean
	0	30	
T_1	2.88	3.55	3.21
T_2	2.23	3.39	2.81
T_3	1.50	2.22	1.86
T_4	0.60	1.03	0.82
Mean	1.80	2.54	
	SE±	C.D. at 5%	
Treatment(T)	0.053	0.160	
Storage(S)	0.151	0.453	
Interaction(TXS)	0.075	0.226	

*Maltodextrin levels (%) - T_1-10%, T_2-15%, T_3-20% and T_4-25%

protein content of the powder shows an decreasing trend during storage period of 30 days. This might be due to the oxidative changes in the product during storage Le Van Viet Man *et al.,* 2009. The fat content in coconut milk powder was significantly decreasing by increasing the level of maltodextrin. The coconut milk powder with 10 per cent maltodextrin recorded the highest mean fat content. When coconut milk powder kept at ambient temperature for a period of 30 days exhibited a decrease in fat content. All treatments showed declining trend during storage. This might be due to the oxidative changes in the product during storage. Similar trend was also observed by Le Van Viet Man et *al.,* 2009 while studying the chemical composition of coconut milk powder.

It is evident from the obtained data that the moisture of coconut milk powder varied significantly with different recipe treatments as well as storage period. The moisture in coconut milk powder found an increasing trend during storage period of 30 days. Increase in the moisture content may be due to absorption of moisture from the atmosphere by the package as there was higher relative humidity during storage at ambient conditions. The observations similar to this finding were also reported by Laksono and Kumalaningsih, 2000, Santana *et al*., 2006 and Le Van Viet Man, 2009 in spray dried coconut milk powder. The water activity in coconut milk powder declined by different levels of maltodextrin and it was influenced in 30 days storage period. their interactions resulted

Table 3. Changes in Water activity of coconut milk powder during storage

Treatments*	Water activity (a_w)		
	Storage period (days)		Mean
	0	**30**	
T_1	0.34	0.58	0.46
T_2	0.30	0.40	0.35
T_3	0.25	0.38	0.30
T_4	0.20	0.31	0.25
Mean	0.27	0.41	
	SE±	C.D. at 5%	
Treatment(T)	0.050	0.150	
Storage(S)	0.142	0.427	
Interaction(TXS)	0.071	0.213	

*Maltodextrin levels (%) - T_1-10%, T_2-15%, T_3-20% and T_4-25%

Table 4. Changes in protein (%) content of coconut milk powder during storage.

Treatments*	Protein (%)		Mean
	Storage period (days)		
	0	30	
T_1	8.38	2.24	5.31
T_2	7.43	2.34	4.89
T_3	5.38	2.67	4.03
T_4	3.35	2.72	4.02
Mean	6.14	2.49	
	SE±	C.D. at 5%	
Treatment(T)	0.148	0.446	
Storage(S)	0.420	1.261	
Interaction(TXS)	0.210	0.630	

*Maltodextrin levels (%) - T_1-10%, T_2-15%, T_3-20% and T_4-25%

Table 5. Changes in fat (%) content of coconut milk powder during storage.

Treatments*	Fat (%)		Mean
	Storage period (days)		
	0	30	
T_1	54.20	26.02	40.11
T_2	49.31	12.91	31.11
T_3	45.49	9.38	27.43
T_4	38.01	7.69	22.85
Mean	46.75	14.00	
	SE±	C.D. at 5%	
Treatment(T)	2.592	7.772	
Storage(S)	7.333	21.984	
Interaction(TXS)	3.666	10.992	

*Maltodextrin levels (%) - T_1-10%, T_2-15%, T_3-20% and T_4-25%

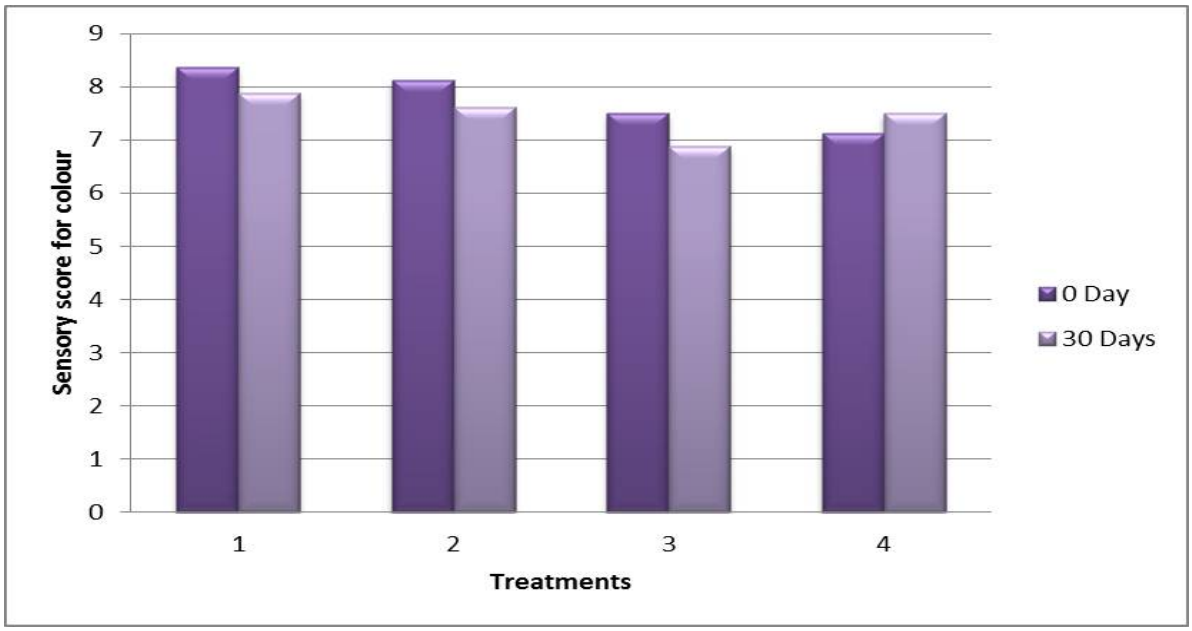


Fig. 1. Changes in sensory score for colour of coconut milk powder during storage
*Maltodextrin levels (%) - T_1-10%, T_2-15%, T_3-20% and T_4-25%

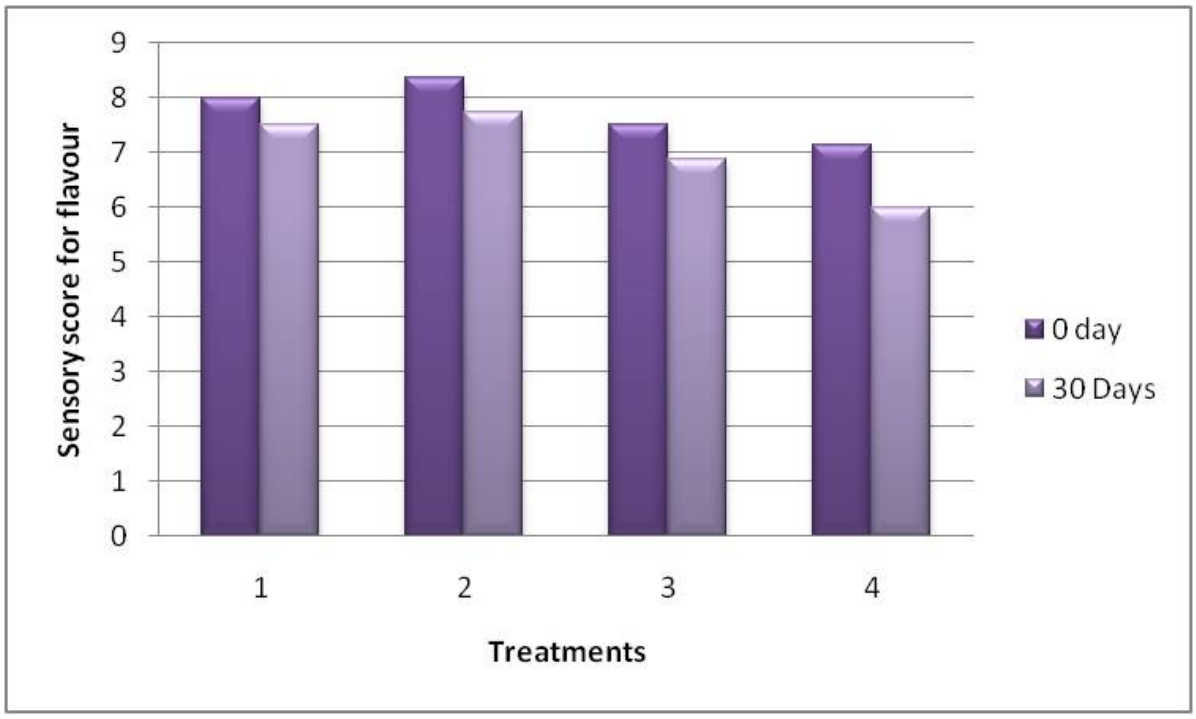


Fig. 2. Changes in sensory score for flavour of the coconut milk powder (Solkadhi) during storage *Maltodextrin levels (%) - T_1-10%, T_2-15%, T_3-20% and T_4-25

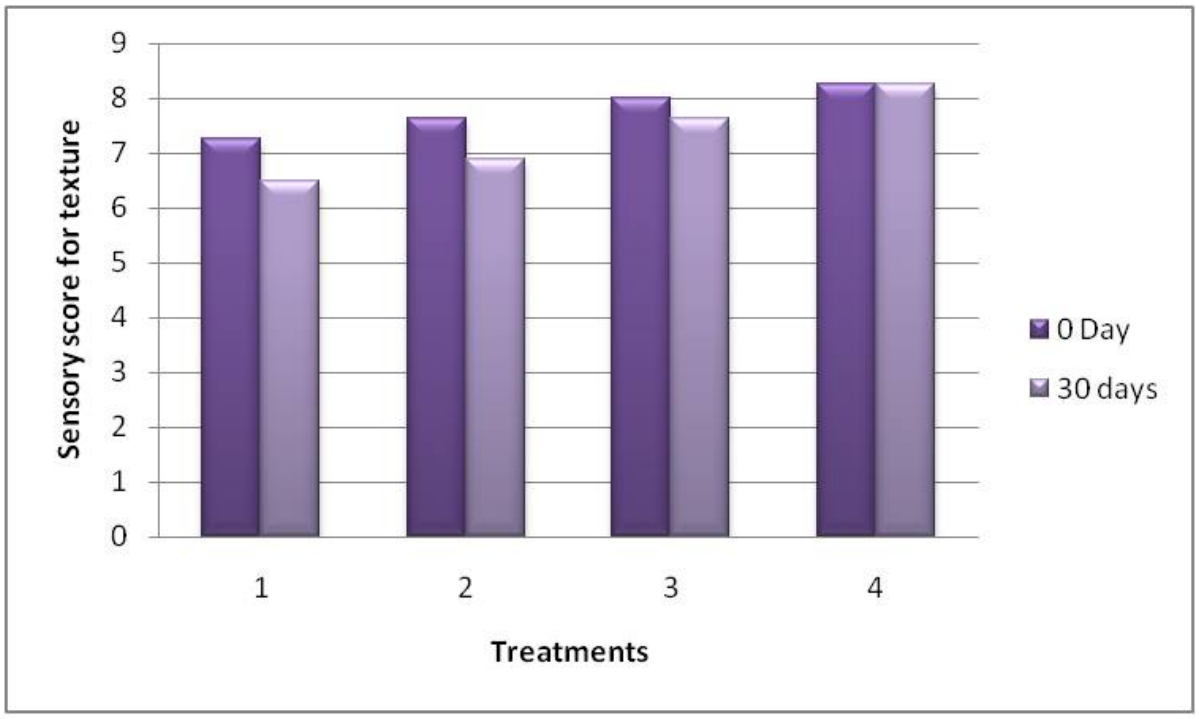


Fig. 3. Changes in the sensory score for the texture of coconut milk powder during storage Maltodextrin levels (%) - T_1-10%, T_2-15%, T_3-20% and T_4-25%

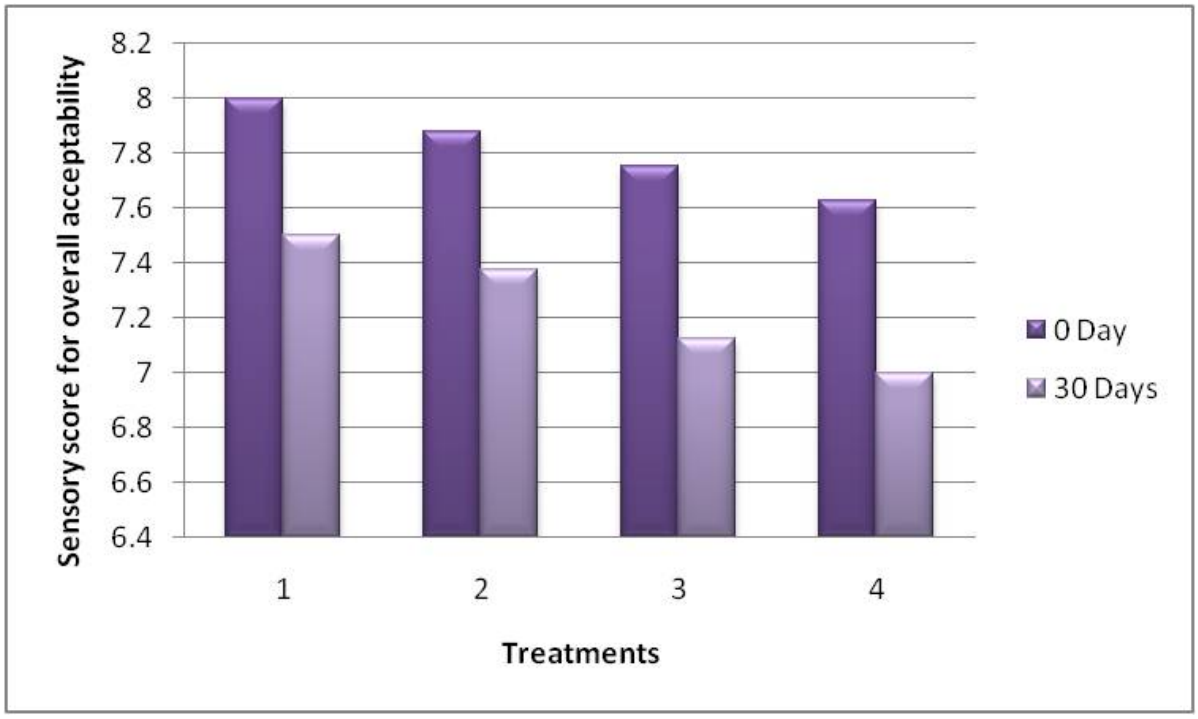


Fig. 4. Sensory evaluation of overall acceptability of coconut milk powder during storage
*Maltodextrin levels (%) - T_1-10%, T_2-15%, T_3-20% and T_4-25%

non-significant. The observations are in accordance with findings reported by Mirela *et al*., 2009, while studying the chemical composition of cashew apple powder and Thankitsunthorn *et al*., 2009 in spray dried Indian Gooseberry powder had. Organoleptic quality determines the storage stability of the product. Coconut milk powder prepared with 15 per cent maltodextrin, 5 per cent skim milk i.e. treatment T_2 recorded the best score of 7.75 for colour, 7.20 for flavour, 8.56 for taste and for 7.62 for overall acceptability. In present finding, there was decrease in organoleptic score of coconut milk powder during ambient storage. Similar observations were also recorded by Weerachet *et al.,* 2009 on spray drying of pineapple juice using maltodextrin as an adjunct.

The present study revealed that the maltodextrin levels exhibited a significant variation with respect to the chemical parameters such as moisture, water activity, protein and fat content of the coconut milk powder and also the sensory qualities of powder and Solkadhi prepared from coconut milk powder. Based on the overall acceptability, the addition of maltodextrin @ 15 per cent would be recommended for the preparation of high quality spray dried coconut milk powder.

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