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Effect of different types of packaging materials on quality aspects of turmeric powder over a storage period

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Abstract
Turmeric (*Curcuma Longa*) is one of the essential elements of the Indian recipes. Besides the taste and aroma, it is also being used for medicinal value since ancient times. It was popular even in Vedic times because of its unique flavour and medicinal properties and its significance in religious ceremonies and auspicious occasions. Turmeric has very good nutritive and medicinal values. The present investigation is aimed to study the storability of ground turmeric powder stored in different packaging materials *viz.*, LDPE, LLDPE, plastic jar (commercial food grade), glass jar, and steel jar over a period of time on the quality of the turmeric powder. Two distinct processing methods commonly adopted for the processing of turmeric i.e. fresh turmeric rhizomes directly converted into powder without boiling and second with boiling of fresh rhizomes with 0.05% sodium bicarbonate solution for 45 minutes followed by cutting into pieces and drying. The powders so obtained were stored in different packaging materials and sealed. The packets or the jars containing turmeric powder were then stored in two different environment *viz.*, normal (room temperature) and refrigerated condition (7-8 °C) and quality analysis was done at a regular interval of 15 days and storage study was continued for period of 180 days.
The value of curcumin content and olioresin content was decreased from 3.11 percent to 1.88 percent and 11.55 to 8.83 percent respectively over a period of storage and found best followed sequence of packaging materials are plastic container, steel container, glass container, LDPE and LLDPE with both cured and non-cured samples. The turmeric powder prepared from curing processing technique, storage at refrigerated condition in plastic container shows higher acceptability in comparison to others.

Keywords: Curcumin percent, oleoresin percent, packaging materials, storage, turmeric powder

Introduction
Turmeric (*Curcuma longa*) is one of the essential elements of the Indian recipes. Besides the taste and aroma, it is also being used for medicinal value since ancient times. It was popular even in *Vedic* times because of its unique flavour and medicinal properties and its significance in religious ceremonies and auspicious occasions (Jacob, 1995). Turmeric is a spice derived from the rhizomes of *curcuma longa*, which is a member of the ginger family Zingiberaceae. The root or rhizome has a tough brown skin and bright orange flesh. Fresh rootstock has an aromatic and spicy fragrance, which on drying generates a peculiar medicinal aroma. The bright yellow colour of turmeric comes mainly from polyphenolic pigment curcuminoids (Aggarwal *et al*., 2007) [1].
In Chhattisgarh, turmeric is an important cash crop grown by tribal families for their livelihood and more than 50% of these crop growers are tribal family. Chhattisgarh contributes about 11.80% of India's turmeric cultivation in terms of area. The total turmeric production in Chhattisgarh is about 83,470 MT from 9747 ha area. (Annual report of horticulture, 2013-14). In the state of Chhattisgarh, Korba, Jagdalpur, Sarguja, Jashpur, Kondagaon, Balod, Surajpur and Balrampur are some of the major turmeric producing district.
The curcumin present in the turmeric is the major active ingredient present in the turmeric having major medicinal benefits. External application relieves pain and swelling, heals wounds and treats many skin diseases ranging from acne to leprosy. Turmeric supports the heart by inhibiting the accumulation of platelets which reduce the chance of heart attack or stroke. It is used as blood purifier and supports the respiratory system as an anti-oxidant to protect lungs from pollution and toxins. The major chronic disease including atherosclerosis, cancer, cardiovascular diseases, cataracts, and rheumatoid arthritis are relieved with anti-oxidants present in turmeric.
During processing and storage of food material most of the active ingredients lose its strength, quality, colour and nutritional value. Rate of losing quality varies based on the type of

packaging material, surrounding conditions and storage conditions. There are various packaging materials generally used in household for storing spices (Roy *et al*, 2012) [5] and they have various categories. Looking towards the importance of turmeric powder and its active ingredients present investigation was plan to study the effect of different packaging material, storage period and storage condition on active ingredient present in turmeric.

Material and Method

Raw material and sample preparation

The fresh turmeric rhizome of local variety (*Shillong*) was purchased from the Raipur local market. After cleaning and grading healthy rhizomes were selected for the study. The initial moisture content of turmeric rhizome samples was determined as described by Ranganna 1995 [4].

Methods of Processing

Improved scientific method of curing: In this method of curing the cleaned fingers (approximately 10 kg) are taken in a perforated trough of size 0.3×0.3m made of GI sheet with extended parallel handle. The perforated trough containing the fingers immersed in the pan containing water. The sodium bicarbonate (0.05%) is added to make the solution alkaline. Turmeric fingers are immersed in the alkaline solution for boiling. The wholesome is boiled (45 min) or till the fingers become soft. The cooked fingers are taken out of the pan by lifting the trough and draining the water into the pan.

Pre-treatments

The present study was carried out to observe the effect of two different processing techniques (curing and non-curing) on active ingredient properties of dried turmeric powder over a period of storage at different packaging materials during ambient (room temperature) and at low temperature (20°C). The following pre-treatments were given to the turmeric rhizome. For each treatment the sample handled was 3 kg for curing/boiling and for non-boiling sample *i.e.* fresh rhizomes direct cut into the sample.

Drying of Turmeric Rhizome

Mechanical tray dryer: The laboratory tray dryer was used for drying of cured and non-cured turmeric samples. It mainly consists of a fan, air-heating chamber, temperature control unit, drying chamber, plenum chamber, hot air inlet, and outlet. Turmeric rhizome of 3 kg for boiled and un-boiled sample respectively were taken and spread uniformly over the trays in single layer.

Fig 1: Boiled turmeric rhizome

Fig 2: Dried turmeric rhizome

Grinding of Turmeric

A pulveriser was used for grinding dried turmeric rhizomes. Pulveriser consist a hopper for feeding, a grinding unit with hammer type arrangement and an outlet.

Packaging of turmeric powder

After grinding both cured and non cured turmeric powder was packed on five types of packaging material namely LLDPE, LDPE, plastic container, glass container and steel container.

Storage of turmeric powder

After packaging both cured and non-cured turmeric powder packets were stored in ambient (28-30 ºC temperature, 48-32.1% RH) and low temperature (20 ºC). The physico-chemical properties were analysed after every 15 days interval up to total 180 days.

Quality analysis

The quality of stored turmeric powder in different packaging material were analysed on the basis of variation in moisture, curcumin and oleoresin content.

Curcumin content, oleoresine content and moisture content was determined by ASTA 1983 [3] and AOAC 2000 [2] methods.

Result and Discussion

1. Effects of storage period and packaging materials on curcumin content present in turmeric powder

The effect of packaging material, storage period, storage conditions (ambient and refrigerated) on curcumin content present in dried turmeric powder is discussed below.

At ambient condition

The curcumin content for the stored sample (pre-treated and non-treated) in ambient condition was gradually decreased over period of time (Fig 3). In case of LLDPE and LDPE decreased in curcumin content was higher *i.e* from 3.11 to 1.72 percent. However in case of glass container, steel container and plastic container decreased value of curcumin content was from 2.39, 2.40 and 2.67 percent respectively. The value of curcumin content for non-cured turmeric powder packed in different packaging materials was found same trend as per pre-treated samples. The value of curcumin content were decrease from 2.19 to 0.53, 0.65, 1.75, 1.86 and 1.89 percent in LLDPE, LDPE, glass container, plastic container and steel container respectively.

At low temperature condition

In low temperature condition curcumin content of cured turmeric powder packed in different packaging materials were decrease from 3.123 percent to 1.772, 1.960, 2.436, 2.393 and 2.774 percent in LLDPE, LDPE, steel container, glass container and plastic container respectively (Fig 4). Initially the sample having higher value of curcumin content, however with the increasing in storage period, the value of curumin content was decreased. Among the all packaging materials the value of curcumin content after 180 days of storage was found lowest in sample packed in LLDPE (1.772) followed by LDPE (1.960), steel container (2.393), glass container (2.436) and plastic container (2.774).

Value of curcumin content for non-cured turmeric powder packed in different packaging materials were decrease from 2.816 to 1.392, 1.654, 1.445, 2.166, 2.393 and 2.654 in LLDPE, LDPE, glass container, steel container and plastic container respectively. Initially the sample having higher value of curcumin content however with the increasing in storage period the value of curcumine content decreases. Among the all packaging materials curcumin content after 180 days of storage was found lowest (1.392) in sample packed in LLDPE followed by LDPE (1.445), glass container (2.166), steel container (2.393) and plastic container (2.654) respectively

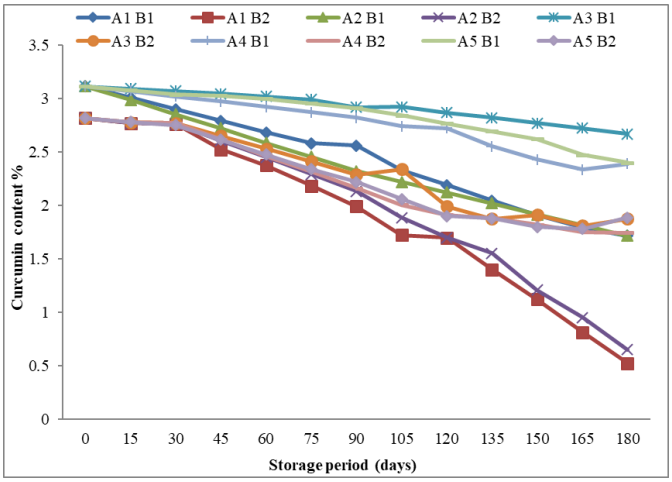

Fig 3: Effects of packaging material on curcumine content of both cured and non-cured turmeric powder under ambient condition

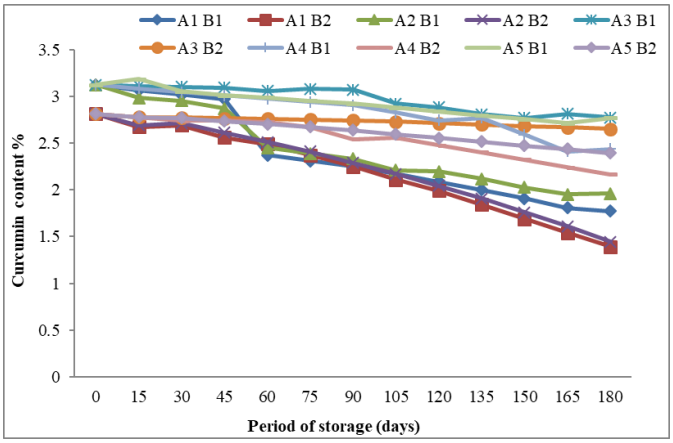

Fig 4: Effects of packaging material on curcumin content of both cured and non-cured turmeric powder under low temperature condition

2. Effects of storage period and packaging materials on oleoresin content

The effect of packaging material, storage period, storage conditions (ambient and refrigerated) on oleoresin content present in turmeric powder is discussed below.

At ambient condition

In cured turmeric powder the oleoresin content decreases from 10.30 percent to 7.01, 7.33, 8.67, 8.84 and 9.35 percent in LLDPE, LDPE, glass container, steel container and plastic container respectively. The overall mean value indicate that sample packed in plastic container has the least decrease in oleioresin content (0.955 percent) followed by turmeric powder packed in steel container, glass container, LDPE and LLDPE with 1.465, 1.632, 2.970 and 3.289 percent respectively over a period of 180 days storage (Fig 5).

In non-cured turmeric powder the oleoresin content decreases from 11.553 to 9.775, 9.851, 10.232, 10.432 and 10.444 in LLDPE, LDPE, glass container, steel container and plastic container respectively. The overall mean value indicate that sample packed in plastic container has least decreased in oleoresin content (1.109) followed by 1.121, 1.321, 1.702 and 1.772 in steel container, glass container, LDPE and LLDPE respectively over a period of 180 days storage.

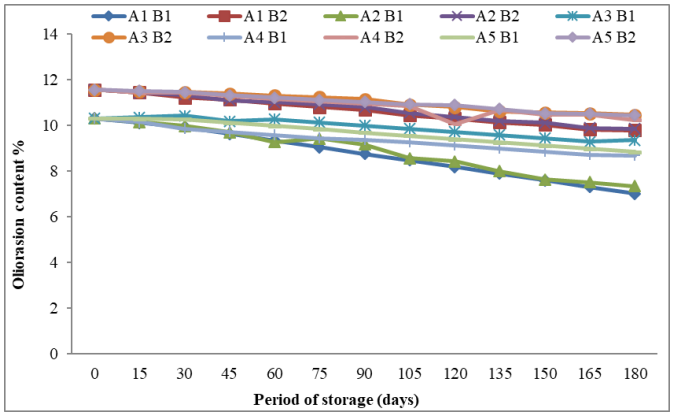

Fig 5: Effects of packaging material on oleoresin content for both cured and non-cured turmeric powder under ambient condition

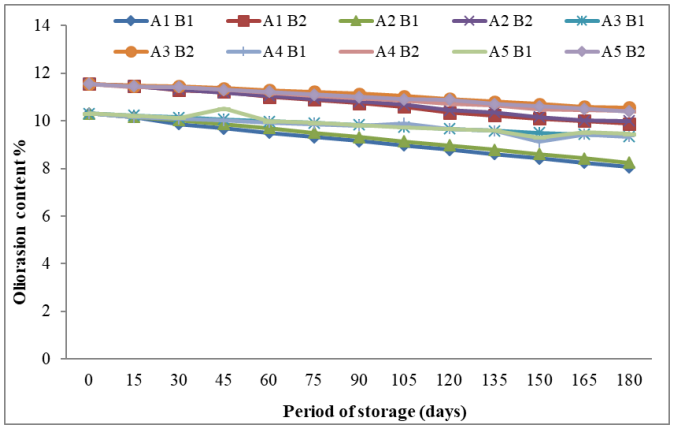

Fig 6: Effects of packaging material on oleoresin content of both cured and non-cured turmeric powder under low temperature condition

At low temperature condition

In pre-treated (cured) turmeric powder the oleoresin content decreased from 10.303 to 8.064, 8.244, 9.335, 9.345 and

9.451 in LLDPE, LDPE, glass container, plastic container and steel container respectively (Fig 5). The overall mean value indicate that sample packed in steel container has the least decrease in oleoresin content (0.852) followed by turmeric powder packed in plastic container, glass container, LDPE and LLDPE with 0.958, 0.968, 2.059 and 2.239 values of oleoresin content respectively.

In non-treated (non-cured) turmeric powder the oleoresin content decreases from 11.553 to 9.887, 9.991, 10.388, 10.411 and 10.555 in LLDPE, LDPE, steel container, glass container, plastic container respectively. The overall mean value indicate that sample packed in plastic container has the least decrease in oleoresin content (0.998) followed by turmeric powder packed in glass container, steel container, LDPE and LLDPE with 1.142, 1.165, 1.562 and 1.666 percent respectively.

3. Effects of storage period and packaging materials on moisture content

The effect of packaging material, storage period, storage conditions (ambient and refrigerated) on moisture content is discussed below.

At ambient condition

In all the samples (treated and non-treated) moisture content of dried turmeric powder was gradually increased with the increased in storage period. In non-cured turmeric powder the moisture content increase from 14.48 to 16.986, 16.876, 15.799, 16.353 and 16.02 in LLDPE, LDPE, steel container, plastic container and glass container respectively. The overall mean value indicate that sample packed in glass container has the least increased moisture content (1.5 percent) followed by turmeric powder packed in plastic container, steel container, LDPE and LLDPE with 1.873, 2.319, 2.396 and 2.506 percent respectively over a period of 180 days storage. In pre-treated (cured) turmeric powder the moisture content increase from 14.601 to 16.77, 16.655, 15.88, 15.82 and 15.66 in LLDPE, LDPE, steel container, plastic container and glass container respectively (Fig 6). The overall mean value indicate that sample packed in plastic container has the least increased in moisture content (1.22 percent) followed by turmeric powder packed in steel container, glass container, LDPE and LLDPE with 1.279, 1.059, 2.054 and 2.169 percent respectively over a period of 180 days storage.

At low temperature condition

In pre-treated (cured) turmeric powder the moisture content increase from 14.40 percent to 16.986, 16.870, 15.956, 15.906 and 15.08 in LLDPE, LDPE, steel container, plastic container and glass container respectively. The overall mean value indicate that sample packed in plastic container has lest increased in moisture content (0.68 percent) followed by turmeric powder packed in steel container, glass container, LDPE and LLDPE with 1.506, 1.556, 2.470 and 2.586 respectively over a period of 180 days storage.

In non-cured turmeric powder the moisture content increase from 14.48 percent to 17.226, 17.116, 15.556, 15.780 and 15.556 in LLDPE, LDPE, glass container, steel container and plastic container respectively. The overall mean value indicate that sample packed in plastic container has the least increased in moisture content (1.076) followed by turmeric powder packed in steel container, glass container, LDPE and LLDPE with 1.30, 1.486, 2.636 and 2.746 respectively over a period of 180 days storage.

Among all the packaging materials, plastic container shows higher acceptability as comparison to other. The lowest change in chemical properties of turmeric powder stored in both ambient and low temperature condition was found in turmeric powder stored in plastic containers. (Fig 7)

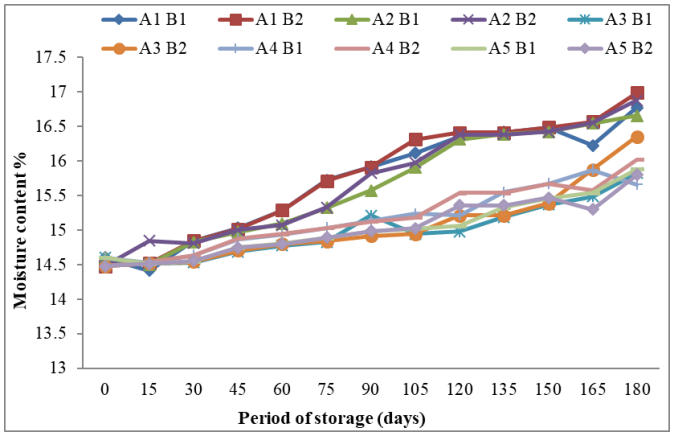

Fig 7: Effects of packaging material on moisture content of both cured and non-cured turmeric powder under ambient condition of storage

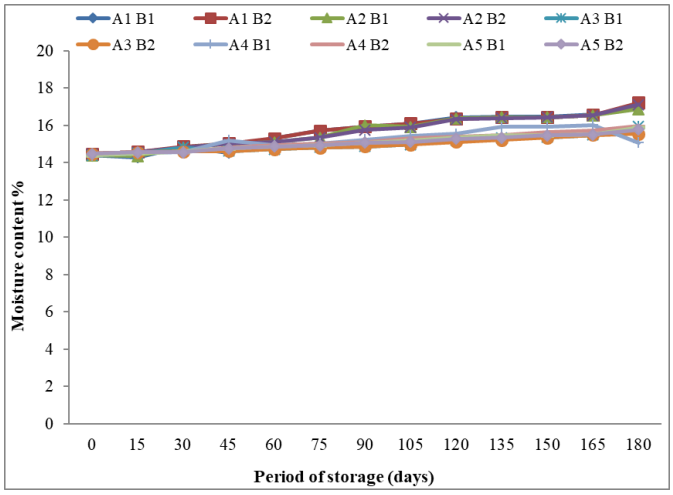

Fig 8: Effects of packaging material on moisture content of both cured and non-cured turmeric powder under low temperature condition

In all graphs A_1, A_2, A_3, A_4 and A_5 refers to packaging materials LLDPE, LDPE, Plastic container, Glass container and Steel container respectively and B_1, B2 refers to processing techniques curing and non curing.

Conclusion

The value of curcumin content and olioresin content was decreased from 3.11 percent to 1.88 percent and 11.55 to 8.83 percent respectively over a period of storage and found best followed sequence of packaging materials are plastic container, steel container, glass container, LDPE and LLDPE with both cured and non-cured samples. The turmeric powder prepared from curing processing technique, storage at refrigerated condition in plastic container shows higher acceptability in comparison to others.

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