Available Online at

http://www.ijcpa.in

October - December 2016

DOI : http://dx.doi.org/10.21276/ijcpa

International Journal of CHEMICAL AND PHARMACEUTICAL ANALYSIS

eISSN: 2348-0726 ; pISSN : 2395-2466

Research Article | Volume-4 | Issue-1 | Article ID: 1165

STRAW AS A UNIQUE DELIVERY SYSTEM FOR HERBAL MEDICINES

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Received: 16 November 2016 / Revised: 21 November 2016 / Accepted: 22 November 2016 / Available online : 31 December 2016

ABSTRACT

Herbal medicines to be taken with water or milk can be easily delivered using straw delivery format. Curcumin was formulated into flavoured granules, which were then incorporated into straw. The straw design prevents the granules from falling out during sipping through milk or water. Curcumin was coated on sugar beads using pan coating process. The content was estimated, and granules equivalent to 15 mg curcumin was filled into the straws. The straws were evaluated in 6 volunteers for taste and feel. The overall feedback from the volunteers regarding easy of sipping, flavor, and feel was good.

Keywords: *Straw, Drug delivery, Curcumin.*

1. INTRODUCTION

Curcumin is a bright yellow chemical produced by some plants. It is the principal curcuminoid of turmeric, a member of the ginger family Zingiberaceae.

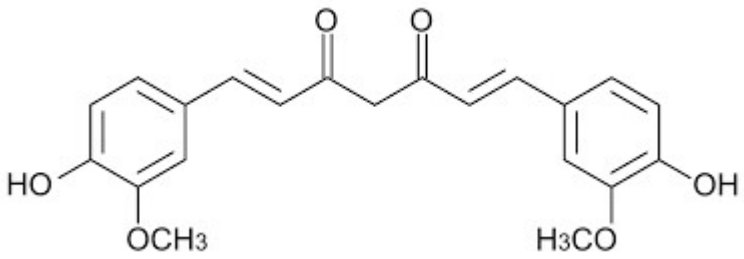

Fig.1 : Structure of Curcumin

It is a small molecule that is a prototypical curcuminoid and has effects similar to other polyphenols. It exerts potent anti-inflammatory effects, and these effects seem to be quite protective against some forms of cancer progression. However it has additional anticancer effects independent of anti-inflammatory effects. It alleviates cognitive decline and has been shown to be effective for Alzheimer.

It has poor oral bioavailability. Piperine from black pepper has been shown to enhance oral bioavailability. Also possible increase in oral bioavailability might be due to the casein in milk.

It is used in case of throat infection along with milk or honey. Also gives relief in joint pains, and arthritic pain. Turmeric is also used in various facial creams, and during weddings along with sandalwood as a paste applied on the skin. Recent studies shows it is effective in Alzheimer.[1-3]

The objective of the present research work was to prepare flavoured granules of curcumin and incorporate it into straw.

2. MATERIALS AND METHODS

Following equipment, instrument, chemicals and reagents were used in the present research work:

2.1 Equipment used in manufacturing

1. Weighing balance
2. Beaker – 100 ml, 250 ml, 500 ml
3. Measuring cylinders – 100 ml, 250 ml
4. Coating pan – 200 – 1000 g capacity
5. Spray gun
6. Hair dryer for drying
7. Straws (empty straws with filters)

2.2 Instruments used in Analysis

1. Analytical balance
2. HPLC Instrument (Shimadzu)
3. HPLC column (C18) – HiQSil, 250 mm length x 4.6 mm dia.
4. Measuring cylinder – Class A apparatus
5. Volumetric flasks – Class A apparatus
6. Pipettes – Class A apparatus

2.3 Chemicals used for Analysis

1. DMSO (Dimethyl sulfoxide)
2. Curcumin Reference standard
3. Citric acid
4. Methanol
5. Ammonia
6. Tetrahydrofuran
7. HPLC grade water

2.4 Materials used for Manufacturing

1. Sugar beads (1.6 mm to 1.8 mm diameter)
2. Pharma grade sugar
3. Purified water
4. Tapioca Starch
5. Sucralose
6. Maltodextrin

7. Orange flavor
8. Cross carmelose sodium
9. Ethanol
10. Curcumin

2.5 Product Development Process

The ingredients used for the development of granules and its composition is given in Table 1. The following method was used for making the granules.[6]

a) Sugar solution was prepared by dissolving 50 g of Pharma grade sugar in 35 ml purified water.
b) Tapioca starch 37.5 g and sucralose 2.5 g were blended in poly bag to form Mix. 1.
c) Maltodextrin 30 g, Orange flavor powder 50 g, Tapioca starch 75 g, crosscarmellose sodium 2.5 g, and Mix I, were blended in another polybag.
d) Curcumin 2.5 gm was dispersed in 25 ml ethanol.
e) Sugar beads 500 gm were placed in a conventional coating pan.
f) The pan was rotated at constant speed. Hot air was blown from the hair dryer on the sugar beads.
g) Temperature of the bed was measured, and when around 55^{O}C, sugar syrup was sprayed from the spray gun. The pan was continuously rotated, with hot air blown from the dryer.
h) Mix II was sprinkled on the sugar beads. Allowed to rotate for 5 minutes, and then Curcumin solution was poured (around 10% of the solution was poured).
i) The pan was rotated continuously, and hot air was blown.
j) Again sugar syrup was sprayed, pan rotated, hot air blown, Mix II sprinkled, pan rotated, hot air blown, curcumin solution (10% of initial quantity), poured, and the process continued, till all the curcumin solution was used.
k) The granules thus formed were dried by rotating in the pan for 30 minutes. They were then dried in an oven for 1 hour at 60^{O}C.
l) The granules were weighed
m) They were then passed through sieve with mesh size 10 and 20. Granules retained on 10 (larger size), and passed through 20 (smaller size) were discarded.
n) Granules that retained on mesh size 20 were even in size, and were used to fill in the straws.
o) Yield was calculated, and is presented in Result and Discussion
p) The granules were analysed for the curcumin content. The details are given in Results and Discussion.

Two batches were taken for reproducibility. The data for second batch is presented in Results and Discussion. Using same formula, 1%, 1.5%, upto 5% of curcumin were loaded, by compensating the quantity of curcumin with Tapioca Starch in Mix 1 and Mix II.

2.6 Method of Analysis (Assay) [4, 5]

The curcumin content in the developed formulation was determined using reverse phase HPLC method.

2.6.1 Chromatographic Conditions

Column:C18 (HiQSil) (250 mm L x 4.6 mm Ø, 5 µ particle size)

Flow Rate: 1.2 ml/min

Injection Volume: 20 µL

Wavelength: 430 nm

Run Time: 20 min.

Mobile Phase: (1% Citric acid) 60% + 40 % Tetrahydrofuran

2.6.2 Standard Preparation

Accurately weigh about 30 mg of curcumin working standard, in 50 ml volumetric flask, add 3-5 ml dimethyl sulfoxide and dissolve completely. Dilute and add sufficient quantity of methanol with continuously stirring and shaking. Make up the volume and sonicate. Transfer 5 ml of stock solution to 25 ml in volumetric flask. Make the volume with mobile phase. Filter through 0.45 µ syringe filter. Inject 20 µL onto the HPLC column and record the chromatograms.

2.6.3 Sample Preparation

Take equivalent amount of sample in 100 ml volumetric flask. Add about 5 ml to 6 ml dimethyl sulfoxide and place on water bath at about 60^{O}C for 5 min. under continuous shaking. Add and make up the volume to 100 ml with methanol with continuous stirring. Take 5 ml solution and dilute to 25 ml. Make up volume with mobile phase and sonicate for 5 minutes Filter through 0.45 µ syringe filter. Inject 20 µL onto the HPLC column and record the chromatograms. System suitability was performed before carrying out the analysis.

3. RESULTS AND DISCUSSION

3.1 Yield Calculations

Evenly distributed granules with yellow to orange color due to the color of curcumin were produced. The yield of good granules which can be used for filling in Straws is as given below:

The weight of Total solids = 500 gm (Theoretical yield considering water and ethanol does not contribute)

Weight of good granules retained on #20 = 370 g

Weight of granules retained on # 10 (oversize) & passed through # 20 (under size) = 75 g

Total granules 370+75 = 445 g

Loss = 55 gm

% Yield of good granules = 370*100/500 = 74%

3.2 Estimation of Curcumin content by HPLC

Results of System suitability Parameters obtained during HPLC analysis are listed below:

i) Number of Theoretical plates of Curcumin peak ≥ 2000

ii) Tailing factor for curcumin is ≤ 2

iii) Retention time for curcumin is 16-18 minutes.

Representative chromatograms of standard and sample are depicted in Fig. 2 and Fig.3 respectively.

The Curcumin content (Assay) was calculated as follows:

Weight of working standard = 30.9 mg

Weight of sample 3062.9 mg

Area of standard = 6571028

Area of sample = 3354175

Potency of Working standard 79.219

$$\% \text{ Assay} = \frac{\text{Area of sample X 30.9 X 5 X 25 X 100 X 100 X 0.79219}}{\text{Area of standard X 50 X 25 X 5 X 3062.9}}$$

= 0.816% curcumin

To fill 15 mg curcumin in one straw , equivalent quantity of granules were used [(15/0.816)x100 = 1838.3 mg = 1.8 g of granules]. Around 2 g of granules were added into the straws, and were given to volunteers for tasting.

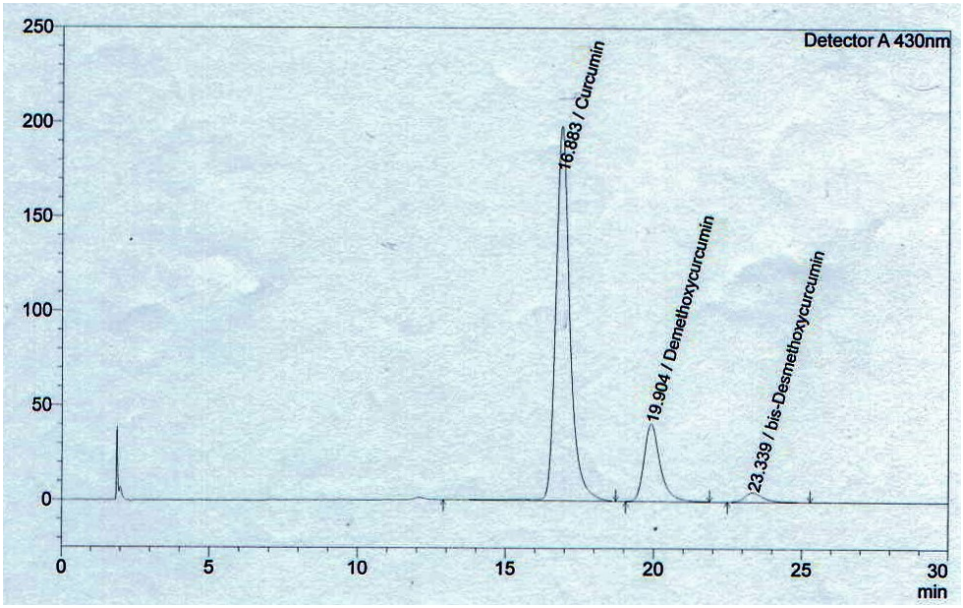

Fig.2: Representative chromatogram of Curcumin standard

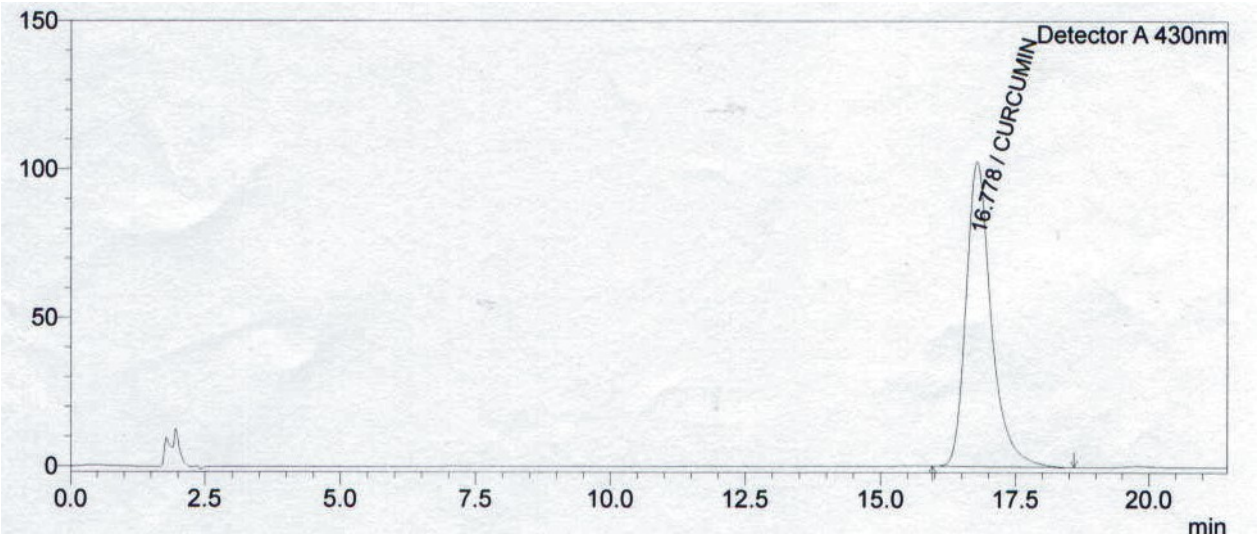

Fig.3: Representative chromatogram of sample

Table 1 : Composition of granules

Sr. No.	Ingredients	Qty gms	%	Rate Rs./kg
1.	Sugar Beads	250	50	75
2.	Purified water	35		10
3.	Pharma grade sugar	50	10	40
Mix. I				
4.	Tapioca starch	37.5	7.5	75
5.	Sucralose	2.5	0.5	3500
Mix II				
6.	Maltodextrin	30	6	50
7.	Mix I			
8.	Orange flavor blen INU 1472 powder	50	10	750
9.	Tapioca Starch	75	15	75
10.	Crosscarmellose sodium	2.5	0.5	2000
11.	Curcumin	2.5	0.5	3500
12.	Ethanol	25		3000
	Total Solids	500	100	

The straws were evaluated in 6 volunteers for taste and feel. The overall feedback from the volunteers regarding easy of sipping, flavor, and feel was good. The results of taste evaluation are depicted in table-2.

Table 2 : Evaluation of Taste

Volunteers	Taste Parameters*				
	Taste	Flavour	Sweetness	Mouth Feel	Overall Experience
Volunteer 1	4	3	4	4	4
Volunteer 2	4	4	4	3	4
Volunteer 3	5	4	4	4	5
Volunteer 4	4	3	4	3	4
Volunteer 5	5	5	4	4	4
Volunteer 6	5	5	5	4	5

*** Taste parameter evaluation scale 1 to 5**

Excellent = 5	**Poor = 2**
Good = 4	**Bad = 1**
Satisfactory = 3	

4. CONCULSION

Curcumin one of the herbal extract of Haldi can be successfully delivered using straws.The curcumin straws were liked by all the six volunteers who participated in the study. Higher percentage of curcumin can be loaded. Along with curcumin, piperine (found in black pepper) can be added to increase its bioavailability. The technology can be applied for other herbal products and to pharmaceutical products as well.

5. ACKNOWLEDGEMENT

The authors wish to acknowledge SRS Pharmaceuticals Pvt. Ltd., for helping with uniquely designed Straws and the project, and Gelnova Laboratories Pvt. Ltd. for helping analysis of curcumin granules. The authors wish to thank Principal K. M. Kundanani College of Pharmacy for allowing to use the product development laboratory of the college.

REFERENCES

1. Unistraw Patent Holdings Ltd., Drink Flavoring Straws, patent No. US 8334003 B2
2. Ringman, J, M., Frautschy S. A., Teng, E., et.al.; *Alzheimer Res. Ther*. 2012, Oct 29; 4(5):43
3. Yang, F.; Lim G.P.; et. al.; Curcumin inhibits formation of amyloid beta oligomers and fibrils, binds plaques and reduces amyloid in-vivo; *J. Biol. Chem*.; 2005, Feb 18, 280(7), 5892-901.
4. Syed, H. K., et.al.; Stability indication HPLC-UV method for detection of Curcumin in Curcuma longa extract and emulsion formulation; *Food Chem*. 2015 Mar 1; 170; 321-6
5. Reversed-phase High-performance Liquid Chromatography Method for Analysis of Curcuminoids and Curcuminoid-loaded Liposome Formulation, R. D. JANGLE AND B. N. THORAT, *Indian Journal of Pharmaceutical Sciences,* January - February 2013, page no. 60 – 66.
6. Influence of Formulation and Process Parameters on Pellet Production by Powder Layering Technique; Claudio Nastruzzi, et.al., *AAPS PharmSciTech,* 2000; 1 (2) article 9