Available Online at

http://www.ijcpa.in

October-December 2019

International Journal of CHEMICAL AND PHARMACEUTICAL ANALYSIS

eISSN: 2348-0726 ; pISSN : 2395-2466

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

Research Article | Volume-7 | Issue-1 | Article ID: 0027

DEVELOPMENT AND EVALUATION OF ORAL CHEWABLE TABLETS AND ORODISINTEGRATING TABLETS OF TULSI LEAF POWDER FOR DIABETIC PATIENTS

Harshal A. Pawar[1], Keval J. Nandu[2], Khilan H. Khimasia[3]

[1] Assistant Professor, Department of Pharmacognosy, Dr. L. H. Hiranandani College of Pharmacy, Ulhasnagar, Maharashtra, India.

[2] Post graduate student, Dr. L. H. Hiranandani College of Pharmacy, Ulhasnagar, Maharashtra, India.

[3] Undergraduate student, Dr. L. H. Hiranandani College of Pharmacy, Ulhasnagar, Maharashtra, India.

***Corresponding Author:** Email: keval.nandu96@gmail.com*

Received: 15 March 2019 / Revised: 13 October 2019 / Accepted: 24 December 2019 / Available online: 31 December 2019

ABSTRACT

The objective of the present research work was to develop and optimize the chewable as well as Orodisintegrating tablet formulation of Tulsi leaf powder. The phytochemical evaluation of Tulsi powder showed the presence of carbohydrates, alkaloids, flavonoids, terpenoids, saponins, glycosides, steroids, and tannins. Tablets of Tulsi powder were prepared by direct compression method. The prepared tablet formulations were evaluated for various post compression parameters. The results obtained for post compression evaluation were within acceptable range. Among all the four formulations, F-1, F-2 and F-3 can be used as chewable tablet since its disintegration time was more, whereas formulation F-4 can be used as orodisintegrating tablet since its disintegration time in water as well as pH 6.8 phosphate buffer was found less than 30 seconds. The chewable and Orodisintegrating tablet formulation of Tulsi leaf powder was successfully developed for diabetic patient. The developed herbal formulations will provide better bioavailability and patient compliance as compared to conventional tablets. The developed formulations presented as alternative to marketed throat lozenges to be used in common conditions of cough and sore throat with wide acceptability among diabetics.

Keywords *– Tulsi, Ocimum sanctum, Chewable tablets, Diabetes.*

1. INTRODUCTION

Ocimum sanctum L. (also known as Tulsi) has been used for thousands of years in Ayurveda for its diverse healing properties. This is a small herb which is found and cultivated all over India and is also worshiped in temples and houses of Hindus. It is commonly known as Tulsi (In Sanskrit), Vishnu-Priya, Kala Tulsi (In Hindi) and India's Holy Basil (In English) [1].

About 35 species of aromatic annual and shrubs and perennial herbs are present in genus of Ocimum. It is mostly native to warm temperate regions of Old World and tropical regions. Few medicinally important species includes [2, 3].

1) *Ocimum canum* is known as lime, hoary and hairy basil. It shows antioxidant and antimicrobial activity [4].

2) *Ocimum basilicum* also known as sweet basil, is a culinary herb. It is used as a folk remedy for many numbers of ailments including cancer, diarrhea, epilepsy, gout, impotency, nausea, sore throat, toothaches, convulsions, whooping cough, and deafness [5].

3) *Ocimum gratissimum* or African basil or Clove Basil. It shows anti-cancer, antitumor, antibacterial, antidiabetic, diarrhea, antifertility, analgesic and hepatoprotective [6].

4) *Ocimum micranthum* also known as Amazonian basil [2]. It shows antioxidant, antiprotozoal and antibacterial activity [7].

5) *Ocimum tenuiflorum* also known as Tulsi, Tulasi, or Holy Basil. It is used in memory improvement and shows antioxidant activity [8].

6) *Ocimum sanctum* also known as Holy Basil in English and Tulsi in Hindi. It is used in anticancer, antidiabetic, anticancer and many other diseases [9].

7) *Ocimum kilimandscharicum* is very important medicinal perennial herb which is mainly distributed in India, Thailand, and East Africa [10].

Different types of constituents in varying amounts are present in different parts of Tulsi plant. Fresh stem and leaves of Ocimum sanctum extract yielded some phenolic compounds (antioxidants) such as eugenol, circimaritin, cirsilineol, apigenin, isothymusin, and rosameric acid. *Ocimum sanctum* leaves contain 0.7% of volatile oil comprising of about 71% eugenol and 20% methyl eugenol [11]. Other constituents present in leaves are Terpiniolene, Isocaryophyllene, β-elemene, Ethyl-2-methylbutyrate, Iso-eugenol, α-amorphene, Ledol, Dimethylbenzene, Sabinene, Limocene, Benzene, Citronellel, Octane, Toluene, Camphene, 14-hydroxy-α-humulene, Selin-11-en-4-α-ol,α-murolene, α-guaiene, α-humulene, Humulene oxide, Elemol, α-terpeneol, Borneol, Tetradecanal, (EZ)-famesol, Calamine, Nerolidol, Cis sesquisainene hydrate, α-bisbolol, Carvacrol and Geraneol [12]. Two flavonoids orientin and andvicenin from aqueous leaf extract of Ocimum sanctum have been isolated [13]. Sesquiterpenes and monoterpenes like Cholesterol, stigma sterol, Neral and Campene are also present [14]. This herb stimulates antibody production up to 20% which provides protection against diseases because of preseance of Vitamin A and Vitamin-C [15, 16].

Ocimum Sanctum (Tulsi) possesses many pharmacological actions such as antimicrobial, wound healing, cough and sore throat, antiviral, antibacterial, anti-protozoal, antifungal, anthelmentic, anti-malarial, anti-diarrhoeal, anti-pyretic, analgesic, central nervous system (CNS) depressant, memory enhancer, hepatoprotective, anti-diabetic, antihyper-cholesterolaemic, anti-asthmatic, anti thyroidic, anticancer, antioxidant, radio protective, immunomodulatory, chemopreventive, anti-fertility, antiulcer, anti-cataract, anti-leucodermal, anti-arthritic, adaptogenic / anti-stress and anticoagulant [17,18].

Several candy lozenges intended for sore throat and cough are available in the market but have high content of sucrose as base. Patients suffering from Diabetes mellitus avoid sucrose containing lozenges; hence, it was felt to develop sucrose-free chewable and orodisintegrating tablets using mannitol as substitute for sucrose- free base. Mannitol reportedly being metabolically inert in humans and could be used as sugar substitute and may have vide acceptability among diabetics. The objective of the present research work was to develop and evaluate the chewable tablets and Orodisintegrating tablet formulation of Tulsi leaf powder.

2. MATERIALS AND METHODS

2.1 Materials

Tulsi leaf powder of edible grade was procured from local market, Mumbai, India. Mannitol was purchased from Molychem laboratories, Mumbai, India. Ludiflash was procured from BASF India Ltd, Navi Mumbai, India. Sucralose was purchased from Dr. Reddy's Laboratories, India. Sodium starch glycolate (SSG) and Cross povidone was obtained from Colorcon Asia Pvt. Ltd. Purified Talc powder and Magnesium stearate were procured from Alpha chemicals laboratory, India.

2.2 Methodology

2.2.1 Preformulation studies

a) UV spectrum: Hydroalcoholic extract of Tulsi leaf powder was prepared by simple maceration using 70% ethanol. The extract was concentrated and was further used for preliminary phytochemical analysis.

b) Calibration curve: Calibration curve of hydroalcoholic extract was constructed by preparing its different concentrations in the range from 0.6 µg/ml to 1.6 µg/ml. UV-spectrum of hydroalcoholic solution was taken by scanning it using UV-Visible spectrophotometer in the range of 200 nm to 400 nm. Λmax was determined. Then the absorbances of all the prepared solutions of different concentrations were taken at the determined Λmax.

c) Tulsi leaf powder was mixed separately with individual excipient in the ratio 1:1 and the mixtures were stored at 40°C and 65% RH in a stability chamber for one month. The organoleptic properties were noted at the end of one month and were compared with the organoleptic properties of the mixture before subjecting to 45°C. The same samples were also extracted in hydroalcoholic solution and their UV-spectrum was taken. The UV-spectrum of all the solutions was overlayed with the UV-spectrum of initial sample before subjecting to accelerated conditions.

2.2.2 Preliminary phytochemical analysis

The hydroalcoholic extract of Tulsi leaves was assessed for the presence of various primary and secondary metabolites using the standard procedures reported in the previously published literature [19-22].

a) Test for Carbohydrates

Molisch Test: A few drops of Molisch's solution was added to 2 mL of aqueous solution of the extract, thereafter a small volume of concentrated sulphuric acid was allowed to run down the side of the test tube to form a layer without shaking. The interface was observed for a purple colour as indicative of positive for carbohydrates.

Barfoed's Test monosaccharides: About 0.5 g each portion was dissolved in distilled water and filtered. 1 ml of the filtrate was then mixed with 1 ml of Barfoed's reagent in a test tube and then heated on a water bath for a period of 2 minutes. Reddish precipitate of cuprous oxide was considered as a positive test.

Fehling's Test for Reducing Sugar: In a test tube 1 ml of Fehling's A and 1 ml of Fehling's B solution were added. These mixed solutions were boiled for a min. Then equal amount (2 ml) of test solution was added. Brick red precipitate was observed which confirmed the presence of reducing sugar.

b) Test for Proteins

Biuret Test: Extract was treated with 1 ml 10% sodium hydroxide solution separately and heated. A drop of 0.7% copper sulphate solution to the above mixtures was added. No formation of purplish violet colour was observed indicated the absence of proteins.

c) Test for Terpenoids

Salkowski test: Extract (5 ml) was mixed with chloroform (2 ml), and concentrated sulphuric acid (3 ml) was carefully added to form a layer. Reddish brown colour observed at the interface indicated presence of terpenoids.

c) Test for Steroids

Liebermann's Test: We added 2.0 ml of acetic acid and 2 ml of chloroform with whole aqueous plant crude extract. The mixture was then cooled, and we added H_2SO_4 concentrated. Green color showed the entity of aglycone, steroidal part of glycosides.

d) Test for Glycosides

Liebermann's Test: We added 2.0 ml of acetic acid and 2 ml of chloroform with whole aqueous plant crude extract. The mixture was then cooled, and we added H_2SO_4 concentrated. Green color showed the entity of aglycone, steroidal part of glycosides.

Keller-Kiliani Test: A solution of glacial acetic acid (4.0 ml) with 1 drop of 2.0% $FeCl_3$ mixture was mixed with the 10 ml aqueous plant extract and 1 ml H_2SO_4 concentrated. A brown ring formed between the layers which showed the entity of cardiac steroidal glycosides.

Salkowski's Test: We added 2 ml H_2SO_4 concentrated to the whole aqueous plant crude extract. A reddish brown color formed which indicated the presence of steroidal aglycone part of the glycoside.

Test for Anthraquinones: 10 ml of benzene was added in 6 g of the *Ephedra* powder sample in a conical flask and soaked for 10 minutes and then filtered. Further 10 ml of 10% ammonia solution was added to the filtrate and shaken vigorously for 30 seconds and pink, violet, or red color indicated the presence of anthraquinones in the ammonia phase.

f) Test for Saponins

Foam Test: 5.0 ml of distilled water was mixed with crude plant extract in a test tube and it was mixed vigorously. The frothing was mixed with few drops of olive oil and mixed vigorously, and the foam appearance showed the presence of saponins.

g) Test for Flavonoids

Shinoda Test: Pieces of magnesium ribbon and HCl concentrated were mixed with aqueous crude plant extract after few minutes and pink colour showed the presence of flavonoid.

h) Test for Alkaloid

Small quantity of concentrated extract was treated with few drops of diluted hydrochloric acid and filtered. The filtrates was divided into four portions and the following tests were carried out –

i) *Dragendorff's Test:* With Dragendorff's reagent (solution of potassium bismuth iodide) formed orange brown precipitate.

ii) *Mayer's Test:* With Mayer's reagent (potassiomercuric iodide solution) formed creamy precipitate.

iii) *Hager's Test:* With Hager's reagent (saturated picric acid solution) formed yellow precipitate.

iv) *Wagner's Test:* With Wagner's reagent (solution of iodine in potassium iodide) formed reddish-brown precipitate.

The formation of respective precipitates indicated the presence of alkaloids.

i) Test for Tannins

Ferric Chloride Test: Extract (0.5 g) was dissolved in distilled water (5 to 10 ml) and filtered. A few drops of 5% ferric chloride solution were added to the filtrate. A greenish black precipitate was formed which confirmed the presence of tannins.

2.2.3 Preparation of tablets

Tablets of Tulsi powder were prepared by direct compression method using Sodium starch glycolate (SSG) as a super disintegrant at concentrations of 10%, 15%, and 20% w/w. All the ingredients were passed through a 40-mesh sieve. A weighed quantity of each ingredient was taken, and the blend (powder mix) was uniformly mixed.

Table-1: Composition of different formulations of Tulsi leaves powder

Sr. no.	Ingredients	F 1	F 2	F 3	F 4	Role
1.	Tulsi leaf powder	250 mg	250 mg	250 mg	250 mg	API
2.	Mannitol	200 mg	150 mg	125 mg	125 mg	Diluent
3.	Ludiflash	100 mg	100 mg	100 mg	75 mg	Base
4.	Sucralose	10 mg	10 mg	10 mg	10 mg	Sweetener
5.	Sodium starch glycolate	-	(10%) 50mg	(15%) 75 mg	(20%) 100 mg	Superdisintegrant
6.	Talc	0.5 %	0.5 %	0.5 %	0.5 %	Lubricant
7.	Magnesium stearate	1 %	1 %	1 %	1 %	Glidant

The powder blend obtained for all the four formulations was compressed using 12 mm standard flat faced round punch on a single station tablet compression machine. The hardness of the tablets was adjusted to 5 kg/cm^2 by adjusting the compression force, with average weight kept around 560 mg ± 5%.

2.2.4 Precompression evaluation of blend

The dry Tulsi powder blend was evaluated for bulk density (P_b), tapped density (P_t); Carr's Index, Hausner's Ratio and angle of repose in order to assess its flow characteristics [23].

Hausner's ratio (HR) and Carr's index (IC) were calculated according to the two equations given below:

$$HR = P_t / P_b$$

$$IC = (P_t - P_b)/P_t \times 100$$

Angle of repose (θ) was determined by pouring the powder through the walls of a short-stem funnel, fixed at a position such that its lower tip was at a height of exactly 2.0 cm above hard surface. The $\tan^{-1}$ of (height of the pile/ radius of the base) gave the angle of repose. Angle of Repose was determined using following procedure:

5 grams of powder was poured gently through a glass funnel into a graduated cylinder. The cylinder was then tapped from a height of 2.0 cm until the time when there was no more decrease in the volume. Bulk density (P_b) and tapped density (P_t) were then calculated [24].

2.2.5 Post compression evaluation of tablets

a) Physical characteristics: The overall elegance, its visual identity and appearance of the tablets is important for consumer acceptance. Size, shape, and organoleptic characters was evaluated of the formulated chewable tablets. Vernier caliper was used for measuring the thickness and diameter of the chewable tablets. Average thickness and diameter were recorded by taking twenty tablets from each batch [25].

b) Weight variation / Uniformity of weight: Randomly from each batch twenty tablets were selected and weighed individually on a digital weighing balance. Individual tablets weight was noted down, and average weight was calculated. The individual weight was compared with the average weight. The individual weight of not more than two tablets must deviate the average weight by ± 5% [26].

c) Hardness: It is the force required to break a tablet across the diameter. The hardness of a tablet represents its strength. Monsanto Hardness tester was used for measuring the hardness. Ten tablets were taken from each batch and average hardness values obtained were expressed in Kg/cm^2.

d) Friability: Roche Friabilator apparatus was used for measuring the friability of the prepared tablets [27]. Pre-weighed twenty tablets were rotated at 25 rpm for 4 min. All the twenty tablets were taken out and de-dusted and were reweighed. The percentage of weight loss was calculated by the formula:

$$\text{Percentage friability} = [(\text{Initial Weight} - \text{Final Weight}) / \text{Initial Weight}] \times 100$$

e) Wetting time: A Petri dish with internal diameter of 5.5 cm containing 6 ml of purified water was taken and a piece of tissue paper folded twice was kept in it. Tablet was placed on the tissue paper such that the upper surface had a small amount of Rosaline dye powder. The wetting time of the tablet was recorded by the time required to develop a red colour on the upper surface [26, 28].

f) Disintegration time: Disintegration time was determined using Distilled water as well as Phosphate buffer (pH 6.8) at 37 ± 0.5°C. The disintegration time of six individual tablets was recorded [29].

g) Assay: 20 tablets were triturated. About 500 mg of the powder was extracted using 50 ml of 70% alcohol solution. The extract was sufficiently diluted, and its absorbance was measured at 259 nm using UV-Visible spectrophotometer. The % drug content were determined using calibration curve. The hydroalcoholic extract was used as a standard.

2.3 Stability study

All the prepared batches / formulations were subjected to stability study as per Ich guidelines for three months at 40 °C / 65 % RH. At the end of three months all the formulations were evaluated for critical parameters like physical appearance, hardness, disintegration time and drug content. The results obtained were compared with initial results of the tablet evaluation.

3. RESULTS AND DISCUSSION

Preliminary phytochemical evaluation indicated the presence of Carbohydrates, Terpenoids and Steroids, Glycosides Saponins, Flavonoids, Alkaloids, Tannins and Phenolic compounds. The results are summarized in table -2.

Table-2: Preliminary phytochemical evaluation of Tulsi leaf powder

Phytochemicals	Inference
Carbohydrates	+
Proteins	-
Terpenoids and Steroids	+
Glycosides	+
Saponins	+
Flavonoids	+
Alkaloids	+
Tannins and Phenolic compounds	+

The UV-Spectrum of the hydroalcoholic extract is represented in Fig. 1. The λmax was found at 259 nm. Therefore, all the quantitative analysis was carried out at 259 nm.

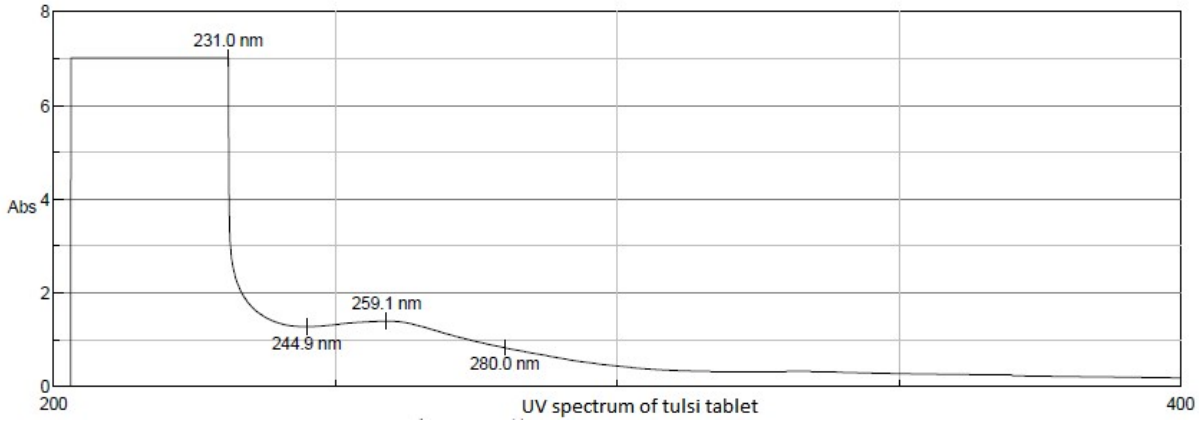

Fig. 1 : UV-Spectrum of hydroalcoholic extract of leaf powder

The result of the calibration curve are represented in table-3. The calibration curve is depicted in Fig. 2.

Table-3: Results of Calibration curve

Concentration (µg/ml)	Absorbance
0.6	0.25
0.8	0.3809
1	0.472
1.2	0.5346
1.4	0.6781
1.6	0.7589

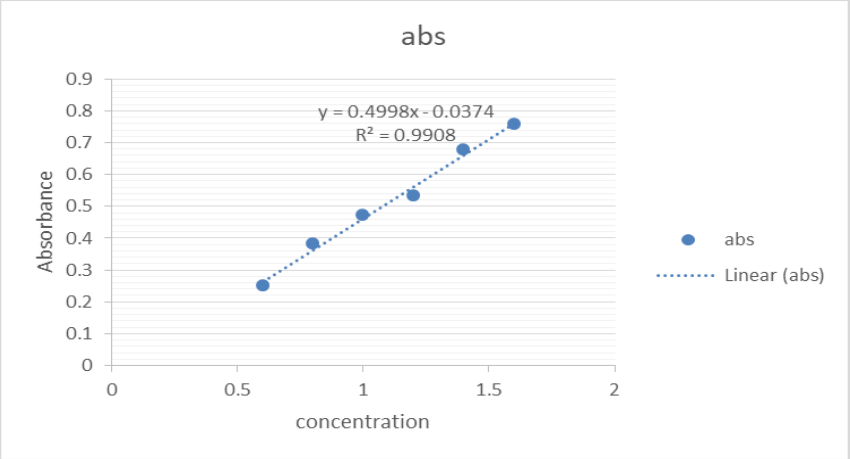

Fig. 2: Calibration curve

All excipients used in the research were found to meet the Pharmacopoeial specifications as mentioned in Indian Pharmacopoeia. During preformulation studies, it was found that all the excipients are physically as well as chemically compatible with extract. The UV-Spectra's obtained for all the mixtures of extract with individual excipient was found overlapping with the spectrum of extract. There was no change in organoleptic properties of mixture, thus indicated physical stability and compatibility of extract with excipient at accelerated condition.

The excipients were selected on the basis of exhaustive literature survey and on trial and error basis. Ludiflash was used as base and it is an all in one solution containing filler, binder, disintegrant that provides tablet with hardness and low friability. Mannitol was used as diluent, Sucralose was used as sweetner, talc was used as lubricant, magnesium stearate was used as glidant, sodium starch glycolate and cross povidone were used as super disintegrant. Sucralose is a non-caloric high intensity sweetener that is approved by FDA. Sucralose does not have a negative impact on people with diabetes. It has zero effect on your blood sugar levels, so there is no need to worry about a spike in sugar. When you eat sucralose, most of the substance passes through your body without being absorbed into your system.

The tablets prepared were of light brown colour with sweet taste and acceptable elegance. Evaluation tests like weight variation, thickness, hardness, diameter, friability, disintegration test and wetting time were done for all the formulations. It is done in order to assess the suitable formulations with respect to its intended therapeutic purpose and the dosage form. The results of precompression evaluation are summarized in table 4.

Table 4: Results of Precompression Evaluation

Sr. No.	Precompression Evaluation Test	F 1	F 2	F 3	F 4
1	Flow Rate (sec)	8.6	5.9	4.4	2.6
2	Angle of Repose	19.02˚	26.56˚	15.67˚	25.01˚
3	Bulk Density	0.4708	0.4708	0.4708	0.4708
4	Tap Density	0.7062	0.7062	0.7062	0.7062
5	Hausner's Ratio	1.5	1.5	1.5	1.5
6	Carr's Index	33.33	33.33	33.33	33.33

The average weight of each formulation was within the acceptable range. None of the tablets were falling outside weight variation limit of ± 5%. The hardness of each formulation was evaluated and found to be 5 kg/cm^2. The thickness of each formulations and was found to be in the range of 0.371 cm to 0.418 cm. Friability was in the range of 0.23% to 0.78%. Friability test of all the formulations were in acceptable range and with value less than 1%. The results of post compression evaluation are summarized in table-5.

Among all the four formulations, F-1, F-2 and F-3 can be used as chewable tablet since its disintegration time was more, whereas formulation F-4 can be used as orodisintegrating tablet since its disintegration time in water as well as pH 6.8 phosphate buffer was found less than 30 seconds.

Tablet 5: Results of Post-compression evaluation of tablets

Sr. no.	Tests	F 1	F 2	F 3	F 4
1.	Wetting time	16.30 mins	5.04 mins	2.15 mins	1.27 mins
2.	Disintegration time in water	4.54 mins	3.10 mins	1.45 mins	25 seconds
3.	Disintegration time in Phosphate buffer (pH 6.8)	7.37 mins	2.45 mins	1.25 mins	22 seconds
4.	Hardness	5 kg/cm^2	5 kg/cm^2	5 kg/cm^2	5 kg/cm^2
5.	Thickness	0.371 cm	0.396 cm	0.396 cm	0.40cm
6.	Diameter	1.22 cm	1.228 cm	1.228 cm	1.23 cm
7.	Weight variation	0.543 ± 0.027	0.550 ± 0.027	0.553 ± 0.027	0.562 ± 0.028
8.	Friability	0.56%	0.33%	0.78%	0.43%
7.	Assay	98.74%	99.21%	98.53%	99.05%

The results of stability study indicated that there is no significant change in physical appearance, hardness, disintegration time and drug content. This indicated that the developed formulations are stable at accelerated condition for three months.

4. CONCLUSION

Oral Chewable and Orodisintegrating tablets of Tulsi leaves powder were successfully formulated. These tablets of tulsi powder can be easily formulated by direct compression method. The formulated herbal tablets will be cost effective and easy to prepare and can be manufactured on large scale in the industry. Although tablets of tulsi have been on the market for some time, they are not the same as the new chewable tablets. Patients for whom swallowing is difficult or painful can easily use these tablets. The developed herbal formulations will provide better bioavailability and patient compliance as compared to conventional tablets. Several allopathic candy-based lozenges for cough and cold are available in the market but contain high concentration of sucrose that are unacceptable for consumption by diabetic patients. The mannitol reportedly being metabolically inert in humans, its tablets may have wide acceptability among diabetics.

REFERENCES

1. Mohan L, Amberkar MV, Kumari M. *Ocimum sanctum* Linn (Tulsi)—an overview. Int J Pharm Sci Rev Res. 2011 Mar 1;7(1):51-3.
2. Drobnick J, editor. The smell culture reader. Oxford: Berg; 2006 Aug 7.
3. Narwal S, Rana AC, Tiwari V, Gangwani S, Sharma R. Review on chemical constituents & pharmacological action of *Ocimum kilimandscharicum*. Indo Global Journal of Pharmaceutical Sciences. 2011;1(4):287-93.
4. Sarma DS, Babu AV. Pharmacognostic and phytochemical studies *of Ocimum americanum*. J. Chem. Pharm. Res. 2011;3(3):337-47.
5. Sullivan C. Herbs, 09 in College Seminar 235-Food for Thought. The Science, Culture, and Politics of Food in Spring. 2009.
6. Ekunwe SI, Thomas MS, Luo X, Wang H, Chen Y, Zhang X, Begonia GB. Potential cancer-fighting *Ocimum gratissimum* (OG) leaf extracts: increased anti-proliferation activity of partially purified fractions and their spectral fingerprints. Ethnicity & disease. 2010 Dec 1;20(1):12.

7. Navarro MC, Montilla MP, Cabo MM, Galisteo M, Cáceres A, Morales C, Berger I. Antibacterial, antiprotozoal and antioxidant activity of five plants used in Izabal for infectious diseases. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2003 Apr;17(4):325-9.
8. Balaji R, Prakash G, Suganya PD, Aravinthan KM. Antioxidant activity of methanol extract of *Ocimum tenuiflorum* (dried leaf and stem). Int J Pharm Sci Rev Res. 2011; 3:20-7.
9. Prakash P, Gupta N. Therapeutic uses of *Ocimum sanctum* Linn (Tulsi) with a note on eugenol and its pharmacological actions: a short review. Indian journal of physiology and pharmacology. 2005 Apr;49(2):125.
10. Saha S, Dey T, Ghosh P. Micropropagation of *Ocimum kilimandscharicum* Guerke (labiatae). Acta Biologica Cracoviensia s. Botanica. 2010.
11. Uma Devi P. Radioprotective, anticarcinogenic and antioxidant properties of the Indian holy basil, *Ocimum sanctum* (Tulasi). Indian J Exp Biol. 2001; 39:185-190.
12. Bano N, Ahmed A, Tanveer M, Khan GM, Ansari MT. Pharmacological evaluation of *Ocimum sanctum*. Journal of Bioequivalence and Bioavailability. 2017;9(3):387-492.
13. Gupta, S.K, Prakash J and Srivastava S. Validation of traditional claim of Tulsi, *Ocimum sanctum* Linn. as a medicinal plant. Indian J Exp Biol. 2002; 5:765-773.
14. Sanctum O. Anti-inflammatory effect of a methanolic extract of leaves of *Ocimum sanctum*. Drug Discov. 2013; 5:23-6.
15. Mondal S, Mirdha BR, Mahapatra SC. The science behind sacredness of Tulsi (*Ocimum sanctum* Linn.). Indian J Physiol Pharmacol. 2009, 53: 291-306.
16. Vidhani SI, Vyas VG, Parmar HJ, Bhalani VM, Hassan MM, et al. Evaluation of Some Chemical Composition, Minerals Fatty Acid Profiles, antioxidant and Antimicrobial Activities of Tulsi (*Ocimum sanctum*) from India. Am J Food Sci Technol. 2016, 4: 52-57.
17. Bano N, Ahmed A, Tanveer M, Khan GM, Ansari MT. Pharmacological evaluation of Ocimum sanctum. Journal of Bioequivalence and Bioavailability. 2017;9(3):387-492.
18. Krishna S. G."Tulsi"-the Wonder Herb (Pharmacological Activities of *Ocimum Sanctum*). American Journal of Ethnomedicine. 2014;1(1):89-95.
19. Debiyi OO, Sofowora FA. Pytochemical screening of medical plants. Iloyidia. 1978; 3:234-46.
20. Roopashree TS, Dang R, Rani SR, Narendra C. Antibacterial activity of antipsoriatic herbs: Cassia tora, *Momordica charantia* and *Calendula officinalis.* International Journal of Applied research in Natural products. 2008 Sep 15;1(3):20-8.
21. Sofowora A., Phytochemical Screening of Medicinal Plants and Traditional Medicine in Africa, Spectrum Books Ltd, Ibadan, Nigeria, 1993.
22. Trease G. E., Evans W. C. Phenols and phenolic glycosides," in Textbook of Pharmacognosy, vol. 12, pp. 343–383, Balliese, Tindall and Co Publishers, London, UK, 1989.
23. Jaimini M, Rana AC, Tanwar YS. Formulation and evaluation of famotidine floating tablets. Current drug delivery. 2007 Jan 1;4(1):51-5.
24. Achhra CV, Pawar HA. Development and Evaluation of Sucrose Free Herbal Orally Disintegrating Tablets of Ginger. Journal of Bioanalysis & Biomedicine. 2017; 9:289-92.
25. Michael EA. Pharmaceutics: The science of dosage form design. London, UK: Churchill Livingstone. 2002:197-210.
26. Rudnic E, Schwartz JB. Oral solid dosage forms In: Remington's Pharmaceutical Sciences. Ed. Gennaro. AR Mack Publishing Company, Pennsylvania, USA. 1990; 18:1633-65.

27. Indian Pharmacopoeia 2007. The Indian Pharmacopoeia. Ministry of Health and Family Welfare, Govt. of India, Controller of Publications, New Delhi 2: 144, 736, 973, 1377.
28. Alanazi FK. Evaluation of spray and freeze-dried excipient bases containing disintegration accelerators for the formulation of metoclopramide orally disintegrating tablets. Saudi Pharmaceutical Journal. 2007;15(2):105-19.
29. Abdelbary G, Eouani C, Prinderre P, Joachim J, Reynier JP, Piccerelle PH. Determination of the in vitro disintegration profile of rapidly disintegrating tablets and correlation with oral disintegration. International journal of pharmaceutics. 2005 Mar 23;292(1-2):29-41.