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Formulation and Evaluation of *Boswellia serrata* Tablets

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An attempt was made to formulate *Boswellia serrata* extract as a conventional tablet using various excipients in different proportions. Herbal raw materials and finished herbal medicinal products specifications were set according to committee for proprietary medicinal products. Eleven such formulations were prepared and evaluated for physical parameters such as thickness, hardness, friability, weight variation, drug content, disintegration time and drug release pattern. The formulations prepared with different proportions of disodium hydrogen phosphate in 10, 15 and 20% as solubilising agent showed maximum drug release. The formulated tablets had better appearance and drug release properties.

The oleo-gum resin of *Boswellia serrata (guggul)*, family Burseraceae, a tree commonly found in India is used for its potent anti-inflammatory and anti-arthritic activity[1] and has been mentioned in the ancient Ayurvedic texts i.e. *Sushruta Samhita* and *Charak Samhita*[2]. The gum contains triterpenic acids α-,β-, and χ-boswellic acid[3] as the principle constituent which is responsible for its antiinflammatory activity [4].

Currently there is a greater global interest in non-synthetic, natural drugs derived from plant/herbal sources due to better tolerance and decreased adverse drug reactions[5]. However, there is a lack of supporting studies regarding the formulation and evaluation aspects. A document on quality control for medicinal plant materials by the WHO (1992)[6] and the note for guidance on specification, by the Committee for Proprietary Medicinal Products (CPMP) 2001[7] are positive measures in this direction. Thus the present study was carried out to formulate tablets of *Boswellia serrata* extract using different excipients in varying proportions and to evaluate its physical parameters and to setup specifications for the finished medicinal product.

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MATERIALS AND METHODS

Boswellia serrata extract standardized to 65% β-boswellic acid and crosscarmellose were obtained as gift samples from Kisalaya Herbals Limited, Indore and Wyeth Laboratories, Goa, respectively. All the chemicals and solvents used were of either pharmacopoeial or analytical grade. Different instruments like a Screw gauge, a Monsanto hardness tester, a Roche friabilator and a Disintegration apparatus were supplied by Campbell Electronics, Mumbai. USP XXIII dissolution apparatus-2 was from Tab-Machines, Mumbai and 1601 PC Shimadzu UV spectrophotometer from Tokyo, Japan.

Herbal raw material specification:

Herbal material specifications were set as per WHO[6] and CPMP[7] guidelines. *Boswellia serrata* extract was studied for different physicochemical parameters like form, colour, odour, taste, total ash, acid insoluble ash, water soluble ash, moisture content, extractive values viz., ethanol soluble extractives, water soluble extractives, petroleum ether extractive, heavy metals, total bacterial count by the procedure given in the WHO guidelines[6] and the Indian Pharmacopoeia 1996[8]. The specifications are given in Table 1.

Formulation of *Boswellia serrata* extract tablets (BSE tablets):

All the formulations were prepared according to Table 2. The drug extract and other excipients were mixed uniformly and made into granules by the wet granulation technique. Either starch paste (20% w/v) or crosscarmellose slurry (5% w/v) was used as a binding agent. The mass was forced manually through sieve no.16 and was dried at 50° for 4 h. The dried granules were passed through sieve No. 22, superimposed on sieve No. 44. The granules retained on sieve No.44 were mixed with 15% fines. The resulting granules were mixed thoroughly with magnesium stearate and talc. The lubricated granules were compressed into tablets in a single punch machine with 500 mg die cavity. Tablet hardness was found to be 3.2 for BSE F-7, 3.5 for BSE F-1, 8, 6 and 10, 3.4 for BSE F-2 and 3, 3.7 for BSE F-4 and 3.8 for BSE F-5, 9 and 11.

Specifications for herbal medicinal product (tablets):

The formulated *Boswellia serrata* extract tablets were studied in accordance with the CPMP guidelines, 2001[7]. Five tablets were taken from each formulation and the thickness of each was determined by using a micrometer screw gauge. Hardness of five tablets from each formulation was determined using a Monsanto hardness tester. The tablet to be tested was held between a fixed and a moving jaw and reading of the indicator adjusted to zero. The force applied to the edge of the tablet was gradually increased by mov-

TABLE 1: HERBAL RAW MATERIAL SPECIFICATIONS OF *BOSWELLIA SERRATA* EXTRACT

Parameters	Specifications
State	Powder
Colour	Cream yellow
Odour	Fragrant balsamic
Taste	Aromatic and slightly bitter
Ash*	
Total ash	1.75%
Water soluble ash	0.43%
Acid insoluble ash	0.33%
Moisture content*	2.6%
Extractive values*	
Ethanol extractive	49.8%
Water extractive	4.91%
Petroleum ether extractive	30.2%
Heavy metals*	
Lead	< 7 ppm
Cadmium	<0.5 ppm
Arsenic	<1 ppm
Total bacterial count	
E. coli	Absent
Salmonella typhi	Absent
S. aureus	Absent

Specifications of *Boswellia serrata* extract. *Values are the mean of three readings expressed in percentage w/w with reference to the air dried drug.

TABLE 2: FORMULATION OF ELEVEN DIFFERENT *BOSWELLIA SERRATA* EXTRACT TABLETS (BSE TABLETS)

Ingredients	BSE F1	BSE F2	BSE F3	BSE F4	BSE F5	BSE F6	BSE F7	BSE F8	BSE F9	BSE F10	BSE F11
Drug	304	304	304	304	304	304	304	304	304	304	304
Starch	100	100	100	100	50	100	100	100	25	25	25
Lactose	64	39	51	——	76	14	04	——	64	39	14
SLS	——	25	——	——	——	——	——	——	——	——	——
DCP	——	——	——	——	——	——	——	64	——	——	——
DSP	——	——	——	——	——	——	——	——	50	75	100
CC	——	——	——	25	50	50	60	——	25	25	25
Talc	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Mg.stearate	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
CCS	——	——	5%	5%	5%	——	——	——	——	——	——
Starch paste	20%	20%	——	——	——	20%	20%	20%	20%	20%	20%

All the formulations contain *Boswellia serrata* extract and all the quantities are in mg per tablet. DCP:Dibasic calcium phosphate, DSP:Disodium hydrogen phosphate, SLS:Sodium lauryl sulphate, CC:Crosscarmellose, CCS:Crosscarmellose slurry.

ing the screw knob forward until the tablet broke. The reading was noted from the scale, which indicated the pressure required in kg to break the tablet.

Uniformity of weight:

Twenty tablets were taken randomly and weighed. The average weight was calculated, then each tablet was weighed individually and weight noted. The weights of individual tablets were then compared with the average weight (already calculated) to determine the percentage variation.

Friability test:

Twenty tablets were dusted, weighed and placed in the Roche friabilator, which was operated for 100 revolutions at 25-rpm. After 100 rotations, the tablets were reweighed and loss in weight was determined. The acceptable limit of friability is 0.5-1%. Initial weight of ten tablets before revolution (W1), final weight of tablets after revolutions (W2) and the percent weight loss (friability) is given by (W1-W2/W1)×100, where W1 and W2 are the initial and final weights of ten tablets.

Disintegration time:

Six tablets were placed in the tubes along with a plastic disc over the tablets. The plastic disc does not allow the tablet to float and imparts a slight pressure on the tablets. The tubes were allowed to move up and down and disintegration time noted when the tablets disintegrated and passed through the sieve[8].

***In vitro* dissolution profile:**

The dissolution profiles of tablets of *Boswellia serrata* extract were determined by using a six panel USP XXIII dissolution apparatus-2 taking 900 ml of physiological buffer solutions of pH 1.2 and pH 7.4 containing 10% of methanol as dissolution media. The dissolution media were maintained at a temperature of 37±1°. The speed of rotation of paddle was 50 rpm[9]. The samples were taken out at appropriate time intervals and the absorbance was noted at 254 nm[10] in a 1601 PC Shimadzu UV spectrophotometer. Ten tablets of each formulation were crushed, shaken with 250 ml of methanol and filtered. The drug content in solution was analysed spectrophotometrically at 254 nm.

RESULTS AND DISCUSSION

Raw material specifications were set up for herbal medicinal materials as per WHO[6] and CPMP[7] guidelines. All specifications fell within the limits prescribed for *Boswellia serrata* extract in literature[3,10]. Eleven tablet formulations of *Boswellia serrata* extract were prepared using various excipients. The prepared tablets showed a fair uniformity of β-boswellic acid content (96-99%). Physical parameters (Table 3) were observed to be fairly good and conforming to requirement. Weight variation was within the IP limit for all eleven-tablet formulations (BSE F-1 to BSE F-11). Average weight of a tablet from all the eleven tablet formulations (BSE F-1 to BSE F-11) was found in the range of 494 mg to 503 mg. In the present study hardness of the tablets from all the eleven formulations was found to be in the range of 3.2 to 3.8 kg/cm^2. Thickness of all the tablets was found in the range of 5.18 mm to 5.63 mm. Friability was in the range of 0.764 to 1.033%. *In vitro* release profile showed that β-boswellic acid was released more rapidly in buffer pH 7.4 than in buffer pH 1.2 (figs.1 and 2) as β-boswellic acid ion-

TABLE 3: STUDY OF PHYSICAL PARAMETER OF FORMULATED *BOSWELLIA SERRATA* EXTRACT TABLETS

Formulation	Thickness(mm)	Hardness (Kg/cm^2)	Friability (%)	Average weight (mg)	Drug content (%)	Disintegration Time (min)
BSE F-1	5.60	3.5	0.931	503.2	97.71	23
BSE F-2	5.45	3.4	0.876	499.7	97.56	26
BSE F-3	5.63	3.4	0.840	495.8	98.65	20
BSE F-4	5.56	3.5	0.654	501.5	98.72	24
BSE F-5	5.59	3.7	1.033	501.4	99.03	26
BSE F-6	5.43	3.5	0.876	494.2	98.06	24
BSE F-7	5.32	3.8	0.765	495.0	97.21	23
BSE F-8	5.18	3.2	0.765	501.3	96.54	23
BSE F-9	5.31	3.8	0.768	500.4	97.65	21
BSE F-10	5.32	3.6	0.764	494.3	96.54	24
BSE F-11	5.31	3.8	0.798	497.9	97.28	27

Physical parameters of the formulated tablets.

izes in alkaline medium. *In vitro* release profiles in buffer solutions of pH 1.2 and pH 7.4 are shown in figs.1and 2 respectively. In case of BSE F-1 containing lactose, 9.3%, and 8.8% of drug was released in acidic and basic media respectively. Incorporation of sodium lauryl sulphate (SLS) at 5% concentration in BSE F-2 improved dissolution of the drug to 12.6% and 15.3% in acidic and basic media respectively. This improvement in dissolution may be due to the surfactant property of SLS.

Formulations employing crosscarmellose slurry at 5% concentration were prepared and evaluated. The dissolution rates of three formulations were studied, one without (BSE F-3) and the other two with 5 % (BSE F-4) and 10% (BSE F-5) crosscarmellose added intragranularly. BSE F-3 without crosscarmellose released 10.0% and 12.4% of the drug respectively in acidic and basic medium. The amount of drug released from BSE F-4 in acidic and basic medium was 17.8% and 26.4% respectively whereas only 15.1% and 20.0% was released from BSE F-5. The release profile showed that an increase in concentration of crosscarmellose increased the release up to a critical concentration of 10% of crosscarmellose. This enhanced release may be due to the disintegrating efficiency of crosscarmellose, a superdisintegrant.

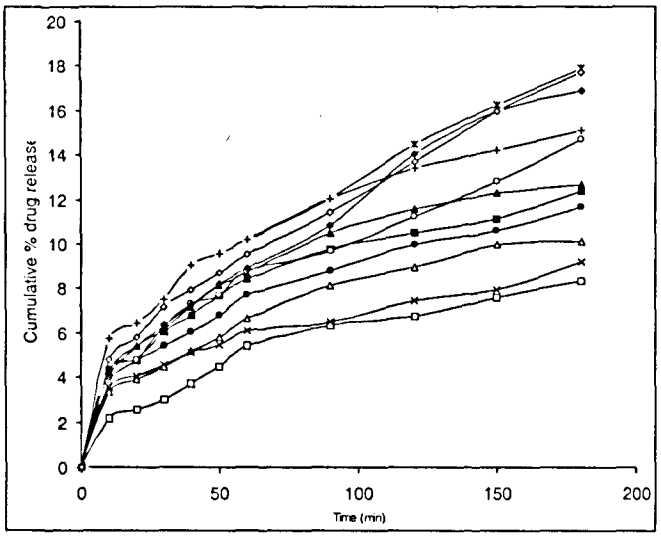

Fig. 1: Cumulative percent drug release of *Boswellia serrata* extract Tablet in pH 1.2 buffer.

***In vitro* dissolution study was carried out in buffer pH 1.2 for 3 h for fabricated tablet Formulations. BSE F-1 (-□-), BSE F-2 (-▲-), BSE F-3 (-△-), BSE F-4 (-*-), BSE F-5 (-+-), BSE F-6 (-●-), BSE F-7 (-◘-), BSE F-8 (-x-), BSE F- 9 (-o-), BSE F-10 (-◆-), BSE F-11 (-◇-).**

Formulations using lactose as a diluent with intragranular crosscarmellose at different concentrations were prepared. Starch paste at 20% concentrations was used as a binding agent and crosscarmellose was added at 10% and 12% concentration levels in BSE F-6 and BSE F-7 respectively. At 10% level 11.6% and 12.5% of the drug were released. In case of formulation containing 12.% crosscarmellose, 12.4% and 12.6% of the drug were released. This confirmed that there was no significant improvement in dissolution above 10% level of crosscarmellose. This may be attributed to the swelling of crosscarmellose which prevents the smaller pores from absorbing water. BSE F-8 containing dicalcium phosphate (DCP) released 9.4% and 10% of the drug in acidic and basic medium.

The effect of disodium hydrogen phosphate (DSP) and intragranular crosscarmellose (5%) on release rate was studied. 10%, 15% and 20% of disodium hydrogen phosphate was used as a solubilizing agent in BSE F-9, BSE F-10, and BSE F-11. Drug release of 14.7%, 36.0% and 16.80%, 46.70% was obtained at 10% and 15% level of DSP respectively, in acidic and basic medium respectively. At 20% concentration level, 17.7% and 46.8% of the drug was released in acidic and basic medium respectively. The results revealed that DSP concentration has an effect on drug release rates. In acidic medium a linear increase in

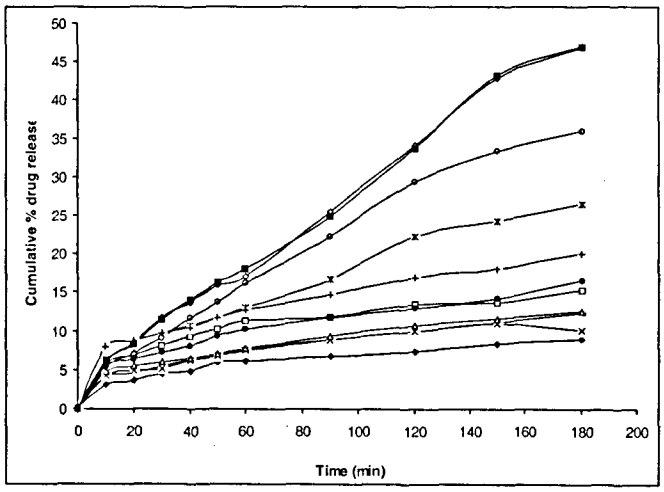

Fig. 2: Cumulative percent drug release of *Boswellia serrata* extract Tablet in pH 7.4 buffer.

***In vitro* dissolution study was carried out in buffer pH 7.4 for 3 h for fabricated tablet. BSE F-1 (-◆-), BSE F-2 (-◇-), BSE F-3 (-□-), BSE F-4 (-*-), BSE F-5 (-+-), BSE F-6 (-●-),BSE F-7 (-△-), BSE F-8 (-X-), BSE F-9 (-o-), BSE F-10 (-◇-), BSE F-11 (-◘-).**

dissolution rates with increase in DSP concentration was found whereas in basic medium this was observed only up to a certain critical concentration of DSP level, i.e. upto 15.0%, concentrations. Above 15.0% no considerable effect was observed on the dissolution profile.

The overall *in vitro* dissolution release profile showed that BSE was released more rapidly in alkaline buffer than in acidic buffer (figs.1and 2). BSE F-10 and 11 prepared with DSP showed maximum release compared to other tablets. Studies showed that BSE F-10 was the best tablet formulation. BSE F-10 and 11 are similar in all respects except DSP concentration and showed the maximum drug release.

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REFERENCES

1. Handa, S.S. and Kaul, M.K., In; Supplement to Cultivation and Uilization of Medicinal Plants, Regional Research Laboratory, Jammu, 1996, 526.
2. Kulkarni, R.R., Patki, P.S., Jog, V.P., Gandage, S.G. and Patwardhan, B., **J. Ethnopharmacol.,** 1991, 33, 91.
3. Rajpal, V., In; Standardization of Botanicals, Vol. I, 1st Edn., Eastern Publisher, New Delhi, 2002, 47.
4. Singh, G.B., Singh, B. and Atal, C.K., **Indian. J. Pharmacol.,** 1984, 16, 51.
5. Kimmatkar, N., Thawani, V., Hingorani, L. and Khiyani, R., **Phytomedicine,** 2003, 10, 3.
6. WHO/PHARM/92.559/rev.1., In; Quality Control Methods for Medicinal Plants Materials, Organsiation Mondiale De La Sante, 1992, 10.
7. CPMP/QWP/2820/00, EMEA/CVMP/815/00, In; Note for Guidance on Specification, Committee for Proprietary Medicinal Products., The European agency for the evaluation of medicinal products, London, 2001.
8. Indian Pharmacopoeia, 4th Edn., Controller of publication, New Delhi, 1996, 947-949.
9. Banker G.S., Anderson, Neil R., In; Lachman L. Eds., The Theory and Practice of Industrial Pharmacy, 3rd Edn., Varghese Publishing House, Bombay, 1987, 293.
10. Mukherjee P.K., In; Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals, 1st Edn., Business Horizons, New Delhi, 2002, 713.