Original Article

Formulation and evaluation of antihelminthic polyherbal tablets

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From time immemorial, man has been depending on plants as medicine. Helminthes infections are among the most common infections in man, affecting a large proportion of the world's population. These helminthic diseases can be treated by various herbal drugs. The purpose of the present work was to formulate antihelminthic tablets. In this work, a spray dried-powder was used, which was obtained from the extract of different part of seven plants that were used in helminthic disease. The different tablets were prepared by using different types of disintegrating agents and various excipients. All parameters related to physicochemical property, trace metal and microbial examination of the spray-dried powder showed that these were within limits and could be used for the tablet formulation. The granules of the spray-dried powder were prepared by a wet granulation technique using isopropyl alcohol. The blends were evaluated for flow properties and for compressibility, which were found to be good. The tablets were prepared using a single rotatory punching machine, in which the punch size was 11 mm×8 mm, and formulated caplet-type tablets. These tablets were evaluated for the colour, odor, thickness and diameter, with visual inspection for any defects, weight variation, hardness, friability and *in vitro* disintegration time.

Key words: Antihelminthic, herbal tablets, spray-dried powder

INTRODUCTION

Plants are always an exemplary source of drug. In fact, many of the currently available drugs were derived either directly or indirectly from the plants. The plant kingdom represents a rich source of organic compounds, many of which have been used for medicinal and other purposes.[1] Herbal medicine remains the major source of health care for the world's population. In the polyherbal antihelminthic tablet formulation, powders of various plants were used, such as *Embilia ribes, Azadirachta indica, Zingiber officinale, Butea monosperma, Cassia aurticulata, Terminalia chebula* and *Ipomoea turpethum.* All the parameters regarding physicochemical, trace metals and microbiological examination were within limits for powders of all the plants.[2-4]

Table 1 shows the part of the plant used for the extraction and the chemical nature of the active ingredient that is responsible for the antihelminthic activity.

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MATERIALS AND METHODS

The spray-dried powders of all seven plants were obtained from Maharshi Ayurveda Product Private Limited, New Delhi, India. All tablet excipients were supplied by Trade Media, New Delhi, India. All other chemicals used in the study were of analytical grade.

Method

Physicochemical properties of different plant powders[2,9,10]

1: Ash values

1.1: Total ash

Weigh accurately into a previously ignited and tarred crucible, usually platinum or silica, about 2–3 g of the ground material. Spread the material in an even layer in the crucible. Ignite the material by gradually increasing the temperature to 500–600°C until free from carbon, cool in desiccators and weigh. Cool the crucible and moisten the residue with about 2 ml of water or a saturated solution of ammonium nitrate, dry on the water bath and then on the hot plate and ignite to constant weight. Then, calculate the content of total ash in mg/g of the air-dried material.

Formula: $\frac{w'_3 - w_1}{w_2 - w_1 (100\text{-}H)} \times 100^4$

w_1 = Empty crucible weight, w_2 = Crucible + sample weight, w_3 = Crucible + sample weight after burning, w'_3 = Weight after desiccate, H = Loss on drying

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Table 1: Major active constituents of plants responsible for the antihelminthic activity[5-8]

Plant	Part used	Active ingredient	Chemical nature	Solvent system
Embilia ribes	Fruits	Embelin	Quinines, alkaloids	Aqueous
Azadirachta indica	Leaves	Nimbedin, nimbin	Glycosides	Aqueous
Zingiber officinale	Dried rhizome	6-giggerol	Phenolic	Aqueous
Butea frondosa	Seeds	Palasonin, albuminoid, palmitic acid and stesric acid	Glycosides	Aqueous
Cassia aurticulata	Leaves	Emodin, chrysophenol,	Glycosides	Aqueous
Ipomoea turpethum	Seeds	Vitamin-c, gallic acid, ellagic acid, scopolatin	Acidic	Aqueous
Terminalia chebula	Fruits	Chebulic acid, tannin terchebin, gallic acid, ellagic acid	Tannins, glycosides	Aqueous

1.2: Acid-insoluble ash

To the crucible containing total ash, add 25 ml of HCl, cover with a watch glass and boil for 5 min. Then, rinse the water-glass with 5 ml of hot water and add this liquid into the crucible. Collect the insoluble matter on the ash-less filter paper and wash with hot water until the filtrate is neutral. Transfer the filter paper containing the insoluble matter to the original crucible, dry on a hot plate and ignite to constant weight. Allow the residue to cool in suitable desiccators for 10 min and weigh without further delay. Calculate the content of acid-insoluble ash in mg/g of the air-dried material.

Formula: $\frac{w'_4 - w_1}{w_2 - w_1 (100\text{-}H)} \times 100^4$

w_1 = Empty crucible weight, w_2 = Crucible + sample weight w_3 = Crucible + sample weight after burning, w_4 = Burn filter paper + crucible weight, w'_4 = Weight after desiccate, H = Loss on drying

2: Moisture content

Moisture content was determined by the oven method. Weigh accurately about 2–5 g of the prepared material or quantity given in the test procedure or previously dried and tarred Petri-dish. Dry in an oven at 100–105°C for 5 h until two consecutive weights do not differ by more than 5 mg, unless otherwise required in the test procedure. Calculate the loss of weight in mg/g in the air-dried material.

Formula: $\frac{w_2 - w'_3}{w_2 - w_1} \times 100$

W_1 = Empty Petri-dish weigh, w_2 = Petri-dish + sample weight, w_3=Petri-dish + sample weight after oven, w'_3 = Weight after desiccate, H = loss on drying

3: Water-soluble extractive

The water-soluble extractive gives the amount of herbal raw material that can be extracted through water.

Transfer the weighed sample (2 g) into a stoppered flask, add 100 ml of water and stopper the flask. Shake at approximately 30-min intervals for 8 h and keep overnight. Shake and filter the extract. Evaporate the half volume of the extract to dryness in a preweighed Petri-dish on a water bath. Heat it in an oven at 105° C and cool to constant weight.

Formula: $\frac{w'_2 - w_1}{(100\text{-}H)} \times 100^4$

H = Loss on drying, w_1 = Empty Petri-dish weight, w_2 = Petri-dish + sample weight, w'_2 = Weight after desiccate, H = Loss on drying

4: Determination of the heavy metals

Trace material or elements and heavy metals (lead, arsenic, cadmium, mercury) analysis can be used as a standardization tool of the plant material. Heavy metals were analysed using an atomic absorption spectrometer(Anallytic Jena).

Formulation development of the polyherbal antihelminthic tablets

For the formulation of polyherbal antihelmenthic tablets, granules were prepared by using isopropyle alcohol. These granules were evaluated for various physical properties like bulk density, tapped density, Hausner ratio, compressibility index and angle of repose.[11,12]

Tablets were prepared using a single rotator tablet punching machine (Hardik Engineering works, Ahmedabad) (10 stations), in which the punch size was 11 mm×8 mm. The composition of the tablets is mentioned in Table 2, in which four disintegrating agents (starch, microcrystalline cellulose, sodium starch glycolate and sodium alginate) were used as the disintegrating agents with different concentrations. Talc was used as a lubricant, acacia gum was used as a binder and lactose anhydrous was used as a filler for preparation of the 1000 mg tablets.

Evaluation of the formulated tablet

1: General appearance

While considering the general appearance, the colour, odour and taste of the tablet were noted.[13]

2: Size and shape

The length, thickness and width of 20 tablets were measured with the help of a thickness tester vernier caliper (Tomar biological center, Agra).[13]

3: Tablet hardness

This was measured using a dial-type hardness tester (Sighla Scientific Industry, Ambala).[13]

4: Friability

The friability test was performed using a Roche friabilator (Sighla Scientific Industry, Ambala).[13]

5: Weight variation test

The weight variation test was carried out by weighing 20 tablets individually, calculating the average weight and comparing the individual tablet weight to the average.[13]

6: Disintegration time

The disintegration time of the tablet was measured in water (37°C) using the USP disintegration test apparatus.[13]

7: Stability studies

The stability study of the formulated tablets was carried out at 40°C and 75% relative humidity using a stability chamber for 2 months.[14]

RESULTS AND DISCUSSION

All the parameters regarding the physicochemical (loss on drying at 150°C, water-soluble matter, total ash and acid-insoluble ash), trace metals (lead, arsenic, cadmium and mercury) and microbiological examinations (total aerobic count, Enterobacteriaceae, *E. coli*, Salmonella sp., yeast, moulds, *Bacillus cereus* and *Pseudomonas aeruginosa*) were within limits as per the Pharmacopoeial specifications.

Table 3 shows that the physical properties of the granules, like bulk density, tapped density angle of repose, Carr's index and Hausner's ratio, were found to be within limits, which shows a good flowability of the granules. The angle of repose, Carr's index and Hausner's ratio were found to be in the range of 21–24, 11.45–14.42 and 1.10–1.17, respectively.

The polyherbal anthelminthic tablets were evaluated for various parameters such as colour, average weight, hardness, friability and disintegration time, which were found to be acceptable as per the Pharmacopoeial specifications. The hardness of the tablets was found to be between 9.00±0.02 and 12.50±0.003 kg/cm^2. The friability of the tablet was found to be below 1%, indicating a good mechanical resistance, and the disintegration time of all the batches was found to lie in the range of 27±0.012–38±0.011 min.

Table 2: Formulation table of batch F1-F12

Batch code	Weight of powder granule (mg)	Starch (mg)	MCC (mg)	SSG (mg)	Sodium alginate (mg)	Talc (mg)	Acacia gum (mg)	Lactose anhydrous (mg)	Total weight of the tablet (mg)
F1	900	20	-	-	-	20	20	40	1000
F2	900	40	-	-	-	20	20	20	1000
F3	900	60	-	-	-	20	20	-	1000
F4	900	-	20	-	-	20	20	40	1000
F5	900	-	40	-	-	20	20	20	1000
F6	900	-	60	-	-	20	20	-	1000
F7	900	-	-	20	-	20	20	40	1000
F8	900	-	-	40	-	20	20	20	1000
F9	900	-	-	60	-	20	20	-	1000
F10	900	-	-	-	20	20	20	40	1000
F11	900	-	-	-	40	20	20	20	1000
F12	900	-	-	-	60	20	20	-	1000

Table 3: Flow property analysis of the granules

Formulation code	Bulk density (g/cm^3)	Tapped density (g/cm^3)	Angle of repose (θ)	Carr's index	Hausner's ratio
F1	0.452±0.010	0.528±0.005	21±1.02	14.34±1.08	1.28±0.040
F2	0.442±0.005	0.508±0.010	24±1.02	13.00±1.08	1.14±0.040
F3	0.512±0.005	0.588±0.010	22±1.06	12.92±1.07	1.15±0.030
F4	0.510±0.020	0.596±0.010	22±1.03	14.42±1.08	1.17±0.050
F5	0.530±0.012	0.606±0.005	24±1.02	12.54±1.06	1.14±0.050
F6	0.523±0.005	0.596±0.020	22±1.03	12.24±1.06	1.13±0.040
F7	0.535±0.005	0.612±0.005	23±1.02	12.58±1.08	1.14±0.050
18	0.525±0.010	0.602±0.003	22±1.04	12.79±1.08	1.14±0.040
F9	0.510±0.010	0.576±0.003	22±1.02	11.45±1.07	1.13±0.030
F10	0.510±0.080	0.596±0.005	22±1.06	14.42±1.02	1.17±0.030
F11	0.535±0.005	0.600±0.01	21±1.02	10.83±1.06	1.12±0.040
F12	0.520±0.005	0.590±0.005	23±1.03	11.86±1.05	1.13±0.040
Range	0.442–0.535	0.508–0.612	21–24	11.45–14.42	1.10–1.17

n=3

Table 4: Evaluation of tablet batch F1-F12

Formulation code	Colour	Average weight (mg)	Hardness (kg/cm²)	Friability (%w/w)	Disintegration time (min)
F1	Dark brown	1001	9.02±0.021	0.49	38±0.011
F2	Dark brown	1000	9.00±0.020	0.44	36±0.012
F3	Dark brown	1002	10.45±0.022	0.39	30±0.005
F4	Dark brown	1001	10.65±0.021	0.38	36±0.021
F5	Dark brown	1002	9.98±0.21	0.45	32±0.020
F6	Dark brown	1000	9.00±0.005	0.43	32±0.003
F7	Dark brown	1001	12.50±0.003	0.28	34±0.005
18	Dark brown	1002	12.0±0.020	0.31	30±0.012
F9	Dark brown	1001	12.01±0.023	0.33	30±0.021
F10	Dark brown	1001	11.25±0.022	0.41	30±0.021
F11	Dark brown	1000	12.00±0.021	0.28	28±0.005
F12	Dark brown	1002	11.65±0.005	0.21	27±0.012
Range	Dark brown	1001–1002	9.00–12.50	0.21–0.49	27–38

n=3

Table 5: Accelerated stability data of the antihelminthic tablets

Storage condition	Description	Average weight (mg)	Hardness (kg/cm²)	Disintegration time (min)	Friability (%w/w)
Initial	Colour: Dark brown Odour: Characteristic	1001	12.00	28	0.28
1 month at 45°C/75% RH	Colour: Dark brown Odour: Characteristic	1001	12.00	29	0.31
2 months at 45°C/75% RH	Colour: Dark brown Odour: Characteristic	1001	13	29	0.29

Product: Antihelminthic tablets; Batch no.: Trial no-F_{11}

On the basis of various specifications, formulation batch 11 was selected as the optimized batch [Table 4].

Stability studies carried out on the final formulation 11 [Table 5] show no significant change in the physical parameters. There was a marginal increase of moisture content and hardness, while no change in the friability was found, showing that these changes were within the specified limits.

CONCLUSION

It was concluded that the antihelminthic could be formulated by different spray-dried products of different plants. The prepared tablets had a good hardness with a satisfactory disintegration time.

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