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(RESEARCH ARTICLE)

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Formulation and evaluation of albendazole tablets drug delivery systems

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Abstract

Albendazole is anti-helminthic drug used to treat a variety of parasitic disorders affecting the intestines and tissues by preventing parasites from absorbing glucose and producing microtubules it works. The purpose of albendazole tablet design is to optimize patient compliance, stability and bioavailability. this review discusses several approaches to making and evaluating albendazole tablets with an emphasis on excipient selection manufacturing processes and quality control measures overall the study shows a significant improvement in therapeutic effectiveness, stability and dissolution rate, highlighting the positive outcomes of developing successful albendazole tablets formulation.

Keywords: Anthelmintic Drug; Albendazole; Tablet Evaluation; Hardness; Friability; Therapeutic Effectiveness; Ascariasis; Hookworm

1. Introduction

Albendazole is a commonly used anthelmintic medication used to treat and prevent a variety of tissue and intestinal parasitic illnesses, including giardiasis, ascariasis, and hookworm infections. It works by interfering with the parasite's glucose absorption, which ultimately results in its death, by disrupting its microtubule structure. Albendazole is now a widely recommended medication in clinical practice as well as public health campaigns because of its broad range of actions and demonstrated efficacy. It has greatly aided in the treatment of parasitic illnesses, which has helped to lower morbidity, raise patient health, and raise the standard of living for those who are affected. Albendazole tablets are made with the intention of making the medication effective, stable, and simple for patients to use. A number of strategies, such as meticulous excipient selection, manufacturing process optimization, and stringent quality control procedures, all contribute to ensuring consistent drug performance and therapeutic results. This review emphasizes the various approaches used in creating and testing albendazole tablets, emphasizing advances made in production, quality assurance, and general efficacy. The review highlights the significance of well-designed formulations in providing albendazole tablets that are both safe and effective by summarizing these methods.

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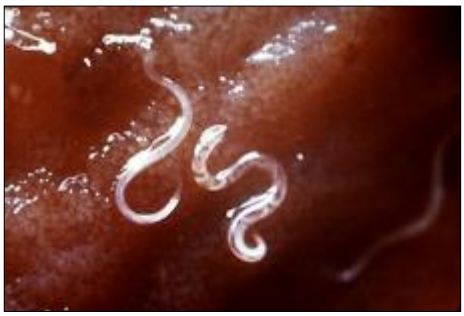


Figure 1 Hookworm Infection

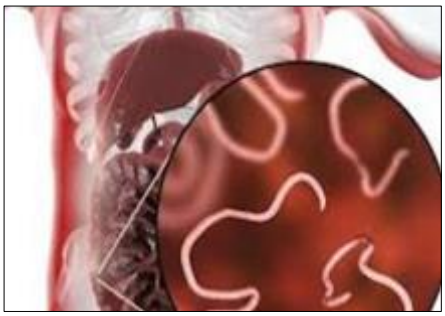
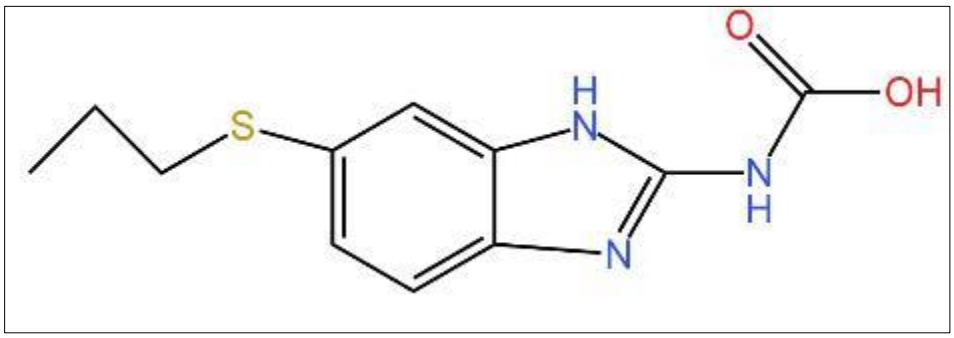


Figure 2 Ascariasis Infection

1.1. Structure of Albendazole



- **IUPAC NAME**: methyl N-(6-propylsulfanyl-1H- benzimidazol-2-yl) carbamate**.**
- **Molecular Formula:** C12 H15 N3O2S
- **Molecular Weight:** 265.33 g/mol

2. Materials and methods

2.1. Material

Albendazole is frequently prepared using excipients like starch, dextrose, sucrose, and gelatin, which serve as diluents and binders. Calcium carbonate (CaCO3), talc, vanillin, and sodium bicarbonate (NaHCO3) are added to enhance pH balance, stability, and flow. These excipients improve palatability and patient acceptability as well. To maximize the medicinal effectiveness of albendazole formulations, such combinations are frequently used.

Table 1 Materials

Sr No.	Name of excipients and API
1	Albendazole
2	Starch
3	Dextrose
4	Gelatin
5	Sucrose
6	Sodium Bicarbonate
7	Talc
8	Vanillin
9	Calcium Carbonate

Table 2 Equipment Used

Sr. No.	Name of Equipment
1	Fourier Transform Infrared Spectrophotometer (IR. Thermoscientific Nicolet is 10)
2	UV/Vis Spectrophotometers Not: Qc. cp-057 (uv jasco 2016)
3	pH Meter H12216 pH/ ORP/ISE Meter
4	Ultra-sonic
5	Electronic Balance Sartorius No: Oc-Cp.059
6	Hardness Tester Rimek- India. No: cp.010.
7	Disintegration Tester (disintegration tester -bj-3)
8	HPIC 2020
9	Dissolution Tester (Rc-80C) No: Qc-cp-071
10	Tablet Machine Rotary tablets press machine Zp-7
11	Friability Tester (Cjy-300D Tablets friability tester)
12	Thickness Tester: Vernier caliper (Stainless hardened)
13	Oven Incubator (Accelerate Stability Study Chamber)

2.2. Method of Preparation (Wet granulation)

2.2.1. Weighing and Mixing

Accurately weigh the required quantities of:

- Albendazole (API)
- Starch (as diluent and binder)
- Dextrose (as sweetener and filler)
- Sucrose (as sweetening and bulking agent)
- Calcium Carbonate (as filler and antacid)
- Sodium Bicarbonate (as disintegrant)
- Vanillin (as flavouring agent)
- Transfer all the weighed powders to a clean, dry mortar.
- Mix thoroughly for 10–15 minutes to obtain a uniform powder blend.

2.2.2. Preparation of Binder Solution

Prepare a **5%** w/v gelatin solution:

- Dissolve 5 g of gelatin in 100 mL of warm water with gentle stirring until a clear solution forms.
- Allow the binder solution to cool to room temperature before use.

2.2.3. Wet Granulation

- Gradually add the prepared gelatin binder solution to the blended powder mixture.
- Mix thoroughly and knead the mass until a damp, cohesive mass is obtained suitable for granulation.

2.2.4. Sieving of Wet Mass

Pass the moist mass through a #16 mesh sieve to form uniform wet granules.

2.2.5. Drying

- Spread the wet granules evenly on trays.
- Dry in a hot air oven at 40–45°C until the moisture content falls below 2%.
- (Drying time: approximately 30–45 minutes, depending on batch size.)

2.2.6. Sizing / Sifting

Pass the dried granules through a #20 mesh sieve to remove lumps and achieve uniform granule size.

2.2.7. Lubrication

- Add Talc (as glidant and lubricant) to the dried granules
- Blend gently in a double-cone blender or mortar for about 5 minutes to ensure uniform distribution without over-lubrication.

2.2.8. Compression

- Compress the final lubricated granules into tablets using a single-punch or rotary tablet press fitted with flat-faced punches.
- Adjust compression pressure to achieve tablets of uniform hardness and weight.

2.2.9. Formulation And Evaluation of Albendazole

Table 3 Formulation Table

Ingredient in mg	**F1**	**F2**	**F3**	**F4**	**F5**
Albendazole	246.2	246.2	246.2	246.2	246.2
Starch	6.2	4.1	_	4.1	4.1
Dextrose	6.2	9.2	6.2	_	6.2
Gelatin	3.1	3.1	6.2	3.1	_
Sucrose	6.2	_	6.2	3.1	6.2
Sodium Bicarbonate	3.1	3.1	3.1	3.1	3.1
Talc	1.2	1.2	1.2	1.2	1.2
Vanillin	1.2	1.2	1.2	1.2	1.2
Calcium Carbonate	0.6	0.6	0.6	0.6	0.6
Total weight	400	400	400	400	400

2.3. Evaluation of Albendazole

2.3.1. Weight Variation

To confirm uniformity in drug content, twenty tablets were randomly selected from each batch (F1–F5) and weighed individually. The average weight of a single tablet was calculated, and deviations of individual tablets from this mean were assessed to ensure compliance with pharmacopeial standards.

2.3.2. Tablet Diameter

The uniformity in tablet size was examined by measuring the diameter of five randomly chosen tablets from each batch using a micrometer. The mean diameter for each formulation was determined to evaluate size consistency.

2.3.3. Tablet Thickness

Tablet thickness was measured using an electronic Vernier caliper on five randomly selected tablets from each batch. The average thickness of the tablets was recorded in millimeters, providing information on dimensional uniformity.

2.3.4. Hardness

The crushing strength of the tablets, which indicates mechanical stability, was measured using a digital hardness tester. Five tablets from each batch were tested, and the mean hardness, expressed in kg/cm^2, along with standard deviation, was calculated to determine the tablets' resistance to mechanical stress during handling.

2.3.5. Friability

Friability testing was performed to assess the tablets' ability to withstand abrasion. A pre-weighed sample of five tablets from each batch was placed in a Roche friabilator and rotated 100 times. The tablets were then weighed again, and the percentage weight loss was calculated. Tablets with a weight loss of less than 1% were considered acceptable.

2.3.6. In-vitro Disintegration

The disintegration test was conducted to evaluate the time required for tablets to break down under standard laboratory conditions. Six tablets from each batch were placed individually in a disintegration apparatus containing distilled water maintained at 37 ± 0.5 °C. The time taken for complete disintegration, leaving no residue, was recorded, and the average disintegration time for each batch was calculated.

3. Result and discussion

Table 4 Evaluation parameters of Albendazole

Formulation Code	Hardness	Thickness	Friability%	Average Weight	Drug Content
F1	3.15 ± 0.08	2.78	0.29	405.3	246.2 ± 1.0
F2	3.25 ± 0.07	2.84	0.25	414.7	246.2 ± 1.1
F3	3.11 ± 0.08	2.80	0.31	429.5	246.2 ± 1.2
F4	3.20 ± 0.06	2.85	0.27	438.8	246.2 ± 1.1
F5	3.13 ± 0.05	2.79	0.28	449.2	246.2 ± 1.2

4. Conclusion

The evaluation of the five Albendazole 400 mg tablet formulations (F1–F5) demonstrated that all batches exhibited satisfactory mechanical strength, uniformity, and drug content, with hardness values ranging from 3.11 to 3.25 kg/cm^2, friability between 0.25 and 0.31 %, and consistent drug content around 246 mg. Variations in excipient composition, including starch, dextrose, gelatin, and sucrose, slightly affected tablet weight and hardness, yet all formulations maintained acceptable physical and quality attributes. These findings align with prior research on Albendazole tablet development, highlighting that careful selection of excipients combined with optimized wet granulation techniques can yield tablets with uniform content, stability, and potential therapeutic efficacy. Minor differences in tablet weight indicate scope for further optimization to enhance dosing precision, but overall, the formulations represent a promising approach for the effective oral delivery of Albendazole.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict-of-interest to be disclosed.

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