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COMPARATIVE ANALYSIS OF CRUDE FIBER AND LAXATIVE POTENTIAL OF FIVE DRY FRUITS IN LOPERAMIDE-INDUCED CONSTIPATION IN ALBINO RATS

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Abstract:

*The primary aim of the study is to treat constipation by evaluating the crude fiber content and laxative activity of selected dry fruits—**Prunus dulcis** (almond), **Juglans regia** (walnut), **Vitis vinifera** (raisins), **Phoenix dactylifera** (date palm), and **Anacardium occidentale** (cashew nut)—through **in vitro** and **in vivo** studies using albino rats. Constipation, a condition marked by difficulty in bowel movement and hardened stools, can be alleviated through dietary fiber, which consists of indigestible polysaccharides and lignin.*

*The crude fiber content of these dry fruits was measured using the **Maynard method (1970)**, and their laxative effects were assessed using the **Capasso method** in rats. Constipation was induced using the drug **loperamide**, and the effectiveness of the dry fruits was observed. The results showed the highest crude fiber content in **walnuts (65%)**, followed by **almonds (42.6%)**, **date palms (19.8%)**, **cashews (13.42%)**, and **raisins (0.8%)**. The corresponding order of laxative activity was **walnuts (80.5%) > almonds (67%) > date palms (43.61%) > cashews (38.79%) > raisins (31.56%)**.*

*The study concludes that **walnuts** exhibited the most effective laxative activity and may serve as a natural remedy for constipation.*

Keywords: *Constipation, crude fiber, laxative activity, Prunus dulcis, Juglans regia, Vitis vinifera, Phoenix dactylifera, Anacardium occidentale.*

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INTRODUCTION:

Constipation is a condition characterized by difficult or infrequent bowel movements, often accompanied by hard stools. It affects a significant portion of the population, ranging from 2–30%, and is especially prevalent among older adults, with 50–75% of those in nursing homes experiencing it. The primary causes of constipation include low dietary fiber intake, inadequate fluid consumption, reduced physical activity, and behavioral habits. In elderly individuals, additional factors such as the side effects of medications, hypothyroidism, and obstructions from colon or ovarian cancer are common contributors. Constipation may also result from conditions like celiac disease, non-celiac gluten sensitivity, or neurological and psychological disorders.

Contributing factors include a diet deficient in fiber, excessive consumption of caffeine or alcohol, endocrine disorders such as hypothyroidism, nervous system diseases, and mental health issues. Diagnosis of constipation involves various tests including blood tests, X-rays, sigmoidoscopy, colonoscopy, anorectal manometry, balloon expulsion tests, colonic transit studies, and defecography or MRI defecography.
Management of constipation involves prevention, medical treatment, and behavioral counseling. Preventive measures include consuming a light and fiber-rich diet composed of foods like wheat, green gram, garlic, seasonal fruits, and green leafy vegetables. It is also important to maintain proper hydration (2–3 liters of fluids daily), establish regular eating habits, avoid spicy and processed foods, and engage in consistent physical activity. Drinking warm water in the morning and avoiding the suppression of natural urges can also aid bowel movements.

Medical management, especially from an Ayurvedic perspective, starts with **Nidana Parivarjana**, which involves avoiding causative factors like poor diet and stress. This is followed by **bio-cleansing therapies** such as **Snehapana** (internal oleation), **Sarvanga Sveda** (sudation), **Virechana** (therapeutic purgation using herbal preparations like Draksha, Haritaki, and Eranda taila), and **Vasti** (medicated enemas using Dashamula and Pippalyadi formulations). Medicated suppositories (Phalavarti) may also be recommended.
Counseling is vital in encouraging patients to establish regular bowel habits, walk daily, drink warm fluids in the morning, consume a healthy breakfast, stay well-hydrated, and eat fiber-rich foods such as beans, whole grains, fruits, and legumes. Patients should be advised not to ignore the urge to defecate and to dedicate a specific time each day for bowel evacuation to promote regularity.

In children, constipation is typically managed with laxatives, primarily polyethylene glycol (PEG). An initial dose of 1–1.5 g/kg/day is used for 3–6 days to relieve fecal impaction, followed by a maintenance dose of 0.4 g/kg/day for at least two months. If PEG is insufficient, stimulant laxatives may be added.

If left untreated, constipation can lead to complications such as hemorrhoids, anal fissures, fecal impaction, rectal prolapse, and encopresis. Chronic constipation, particularly in older adults, can result in severe outcomes like stercoral ulcers, bowel obstruction, or even colon rupture, which may be life-threatening. Therefore, early recognition, appropriate lifestyle modifications, and timely medical intervention are essential for effective management.
Dietary fibre includes all polysaccharides and lignin not digested by human enzymes. It exists in two forms:

- **Soluble Fibre**: Dissolves in water, is fermented in the colon, and aids in satiety and blood sugar control. Examples include beta-glucans (oats, barley), inulin (chicory root), and psyllium.
- **Insoluble Fibre**: Does not dissolve in water and adds bulk to stool. Found in wheat bran, cellulose, and lignin, it helps regular bowel movements but can cause constipation if too finely milled.

Health Benefits of High-Fibre Diet
A high-fibre diet:

- Improves bowel regularity and gut health
- Lowers cholesterol, blood pressure, and inflammation
- Manages blood sugar levels
- Reduces risks of heart disease and cancer

Fibre Intake
An adult needs 25–35 grams of fibre daily for optimal bowel health.

MATERIALS AND METHODS:

MATERIALS REQUIRED:
CHEMICALS REQUIRED:
Sulphuric acid solution (H_2SO_4),
Sodium hydroxide solution (NaoH),
Petroleum ether,
Distilled water and
Alcohol(ethanol).

PREPARATION OF SOLUTIONS:
Sulphuric acid solution (0.255 ±0.005N) :
1.25g concentrated sulphuric acid diluted to 100mL (concentration must be checked by titration).
Sodium hydroxide solution (0.313 ±0.005N) :

1.25g sodium hydroxide in 100mL distilled water (concentration must be checked by titration with standard acid)

ESSENTIAL INSTRUMENTS:
1. Digestion Apparatus: A multi-unit assembly with rheostat- controlled electric heaters, and condensers to fit 600 mL beakers, designed specifically for crude fiber determinations, is recommended. Heaters must be adjustable to the temperature that will bring 200 mL of water at 25 °C to a rolling boil in 15 ± 2 minutes (Note 1).
2. Filtering Device: A California Modified Buchner Funnel, two-piece polyethylene, with a 200 mesh stainless steel screen, is recommended.
3. Muffle Furnace: Equipped with a pyrometer and capable of operating at temperatures up to 600 °C.
4. Drying Oven: Forced draft or convection air oven, operating at 130 ± 2 °C

GLASSWARE:
Test tubes, conical flask, pipettes, beakers, stirrer, measuring cylinder, funnel, centrifuge tubes etc.

MISCELLANEOUS:
Test tube stand, test tube holders, filter paper, butter paper, spatula, thermometers, stands, tissue paper, zip pouches, markers, gloves, labels, cotton swabs, disinfectant etc.

ANIMALS:
Albinos Wistar rats weighing 150-200 g were housed and bred in the animal house. The animals were kept in standard cages with good ventilation, free access to feeds and water. Experimental procedures and protocols used in this study were approved by ethical committee. These guidelines were in accordance with the internationally accepted principles for laboratory use and care.

METHODS:
EXPERIMENTAL PROCEDURE FOR CRUDE FIBER ESTIMATION:
Sample preparation:
The dry fruits were powdered with a mechanical grinder to form a coarse powder. The powder was passed through sieve no 10 and was stored in an air tight container until further use. The powder was used for the extraction process.
Procedure:
1. Extract 5g of dry fruit with petroleum ether to remove fat (Initial boiling temperature 35 -38°C and final temperature 52°C). if fat content is below 1%, extraction may be omitted.
2. After extraction with ether boil 2.5g of dried material with 200ml of sulphuric acid for 30min with bumping chips.
3. Filter through muslin and wash with boiling water until washing are no longer acidic.
4. Boil with 200ml of sodium hydroxide solution for 30min.
5. Filter through muslin cloth again and wash with 25ml of boiling 1.25% H_2SO_4, three 50 ml portions of water and 25ml alcohol.
6. Remove the residue and transfer to ash dish (preweighed dish W_1).
7. Dry the residue for 2h at 130 ±2°C. Cool the dish in a desiccator and weigh (W_2).
8. Ignite for 30min at 600 ±15°C.
9. Cool in a desiccator and reweigh (W_3).

Calculation:

$$\% \text{ crude fiber in ground sample} = \frac{\text{Loss in weight on ignition } (W_2 - W_1) - (W_3 - W_1)}{\text{Weight of the sample}} \times 100$$

Where
$\mathbf{W_1}$ = weights of residue before drying,

$\mathbf{W_2}$ = weight of residue after drying for 2hrs at 130 ±2°C,

$\mathbf{W_3}$ = weight of residue after ignite for 30min at 600 ±15°C.

EXPERIMENTAL PROCEDURE FOR LAXATIVE ACTIVITY ESTIMATION:
Sample preparation:
The dry fruits of Almond, Walnut, Raisins, Cashew nut and Date palm were powdered individually and made a dough using water. This dough was made pellets and dried in oven to make the consistency of rat chow. This rat chow was weighed and subjected to the evaluation for its laxative potential
The method of Capasso *et al.*[43] was followed for this activity.

Rats were divided in seven groups and the dose was given .
1st group : Acting as the control and administered normal saline (1 ml/rat).
2nd group :Acting as the standard and administered castor oil (1 ml/rat).
3rd group : Received Prunus dulcis.
4th group : received Juglans regia.
5th group : received Vitis vinifera L.
6th group : received Anacardium occidentale .
7th group : received phoenix dactylifera.
The initial weight at 0hrs and the final weight at 6hrs and 24 hrs is noted to determine the amount of laxative effect induced.

$$\text{Laxative activity induced} = \frac{\text{Control X - Test/Standard X}}{\text{Control X}} \times 100$$

Where X= Wt. of faeces output from each group.

EXPERIMENTAL PROCEDURE FOR CONSTIPATIVE ACTIVITY ESTIMATION:

For this procedure we've selected five healthy albino rats of weight about 160-200 gms. To observe the constipative effect loperamide has been induced (2mg/kg). After diluting the tablet the drug solution has been given to rats through IP route and it's effect has been observed

Sample preparation: The drug solution is prepared by dissolving 1mg loperamide in 100 ml water and subjected to the evaluation for its constipative property by inducing drug .

Rats were divided in five groups and the dose was given .

1st group : acting as normal

2nd group : Acting as the control and administered normal saline (1 ml/rat/hour).

3rd group : Acting as the standard and administered castor oil (1 ml/rat/hour).

4th group : Loperamide induced and received Prunus Dulcis

5th group : Loperamide induced and received Juglans regia

The initial weight at 0hrs and the final weight at 6hrs and 24 hrs is noted to determine the amount of constipative effect induced.

SAMPLE PREPARATION:

The dry fruits of Almond, Walnut which have shown best laxative activity were powdered individually and made a dough using water. This dough was made pellets and dried in oven to make the consistency of rat chow. This rat chow was weighed and subjected to the evaluation for its treatment of constipation.

Rats were divided in five groups and the feed was given .

1st group : normal group

2nd group : Acting as the control and administered normal saline (1 ml/rat/hour).

3rd group : Acting as the standard and administered castor oil (1 ml/rat/hour).

4th group : received Almond.

5th group : received Walnut.

The final weight at 6hrs and 24 hrs is noted to determine the amount of laxative effect induced.

RESULTS:

TABLE : DATA SHOWING THE AMOUNT OF CRUDE FIBER PRESENT

S.NO	PLANT MATERIALS	WEIGHT TAKEN (in gms)	W_1 (in gms)	W_2 (in gms)	W_3 (in gms)	CRUDE FIBER %
1	Almond	9.96 ±0.02	7.59 ±0.01	4.26	0.01	42.6%
2	Walnut	10.63 ±0.02	9.93 ±0.01	6.34	0.12	65%
3	Raisins	10.00 ±0.01	1.07 ±0.02	0.11	0.03	0.8%
4	Cashew nut	10.50 ±0.02	3.15 ±0.01	1.43	0.02	13.42%
5	Date palm	9.99 ±0.01	7.49 ±0.02	2.02	0.04	19.8%

Where W_1 = weights of residue before drying,

W_2 = weight of residue after drying for 2hrs at 130 ±2°C

W_3 = weight of residue after ignite for 30min at 600 ±15°C.

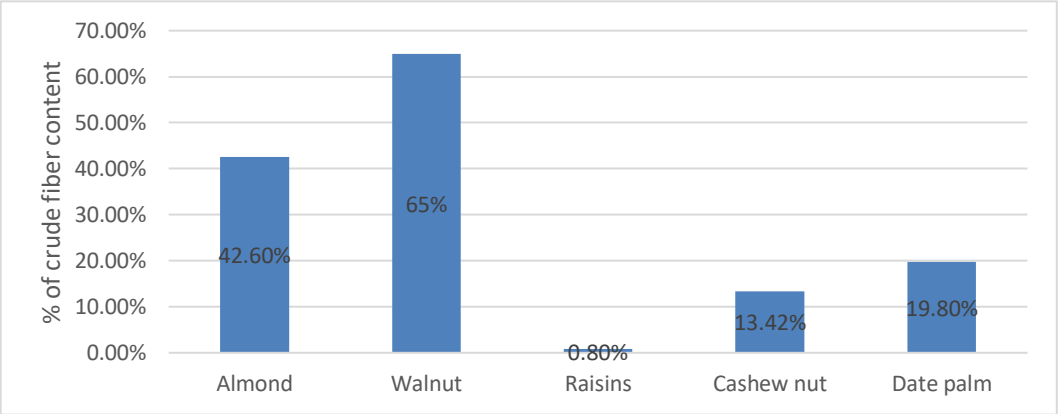


FIGURE : GRAPH SHOWING THE % OF CRUDE FIBER CONTENT

DISCUSSION:

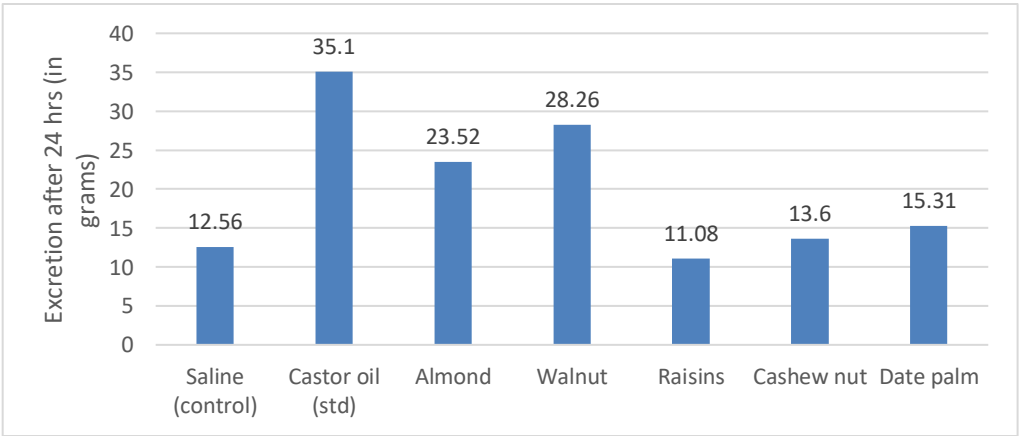
- Complications of constipation include haemorrhoids and anal fissure, faecal impaction, rectal prolapse and encopresis. The crude content of natural foods i.e. dry fruits like walnut, date palm, almond, cashew, raisins are studied by using hennerberg, stohmann and rauterberg method.
- The order of crude fibre content is as follows:

Walnut(65%)>Almond(42.6%)>Date palm(19.8%)>Cashew(13.42%)>Raisins(0.8%).

- Here by, we would like to conclude that "WALNUT" have high amount of crude fibre content and may treat constipation.

TABLE : DATA SHOWING THE AMOUNT OF FAECES OUT PUT AND THE % OF LAXATIVE ACTIVITY

Group no	Treatment	% crude fiber content	Excretion after 24 hours (in grams)	Laxative activity induced on each group (in %)
1	Saline (control)		12.56 ±0.01	
2	Castor oil (std)		35.1±0.01	100%
3	Almond	42.6%	23.52 ±0.02	67%
4	Walnut	65%	28.26 ±0.01	80.5%
5	Raisins	0.8%	11.08 ±0.02	31.56%
6	Cashew nut	13.42%	13.6 ±0.02	38.79%
7	Date palm	19.8%	15.31 ±0.02	43.61%



Number of rats per group(n)= 6

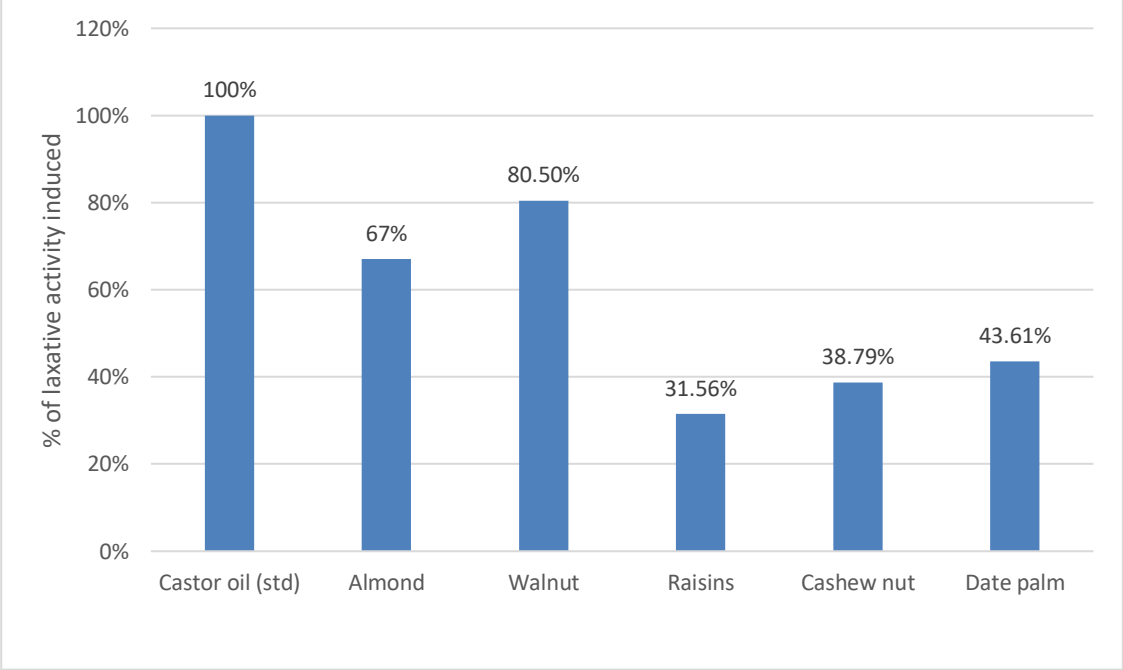


FIGURE : GRAPH SHOWING % OF LAXATIVE ACTIVITY INDUCED

DISCUSSION:

- Complications of constipation include haemorrhoids and anal fissure, faecal impaction, rectal prolapse and encopresis. The laxative activity of natural foods i.e. dry fruits like walnut, date palm, almond, cashew, raisins are studied by using albino rats.
- The order of laxative activity observed is as follows:

Walnut(80.5%)>Almond(67%)>Datepalm(43.61%)>Cashew(38.79%)>Raisins(31.56%).

- Here by, we would like to conclude that "WALNUT" has shown good laxative activity and may treat constipation.

TABLE : DATA SHOWING THE AMOUNT OF LAXATIVE ACTIVITY SHOWN ON EACH GROUP AFTER INDUCING CONSTIPATION BY USING LOPERAMIDE DRUG

Group no	Treatment	Laxative activity induced on each group after 6 hours (in %)	Laxative activity induced on each group after 24 hours (in %)
1	Normal	100%	100%
2	Saline (control)	19.26%	87.31%
3	Castor oil (std)	48.7%	83.7%
4	Almond	34.94%	36.29%
5	Walnut	47.33%	65.83%

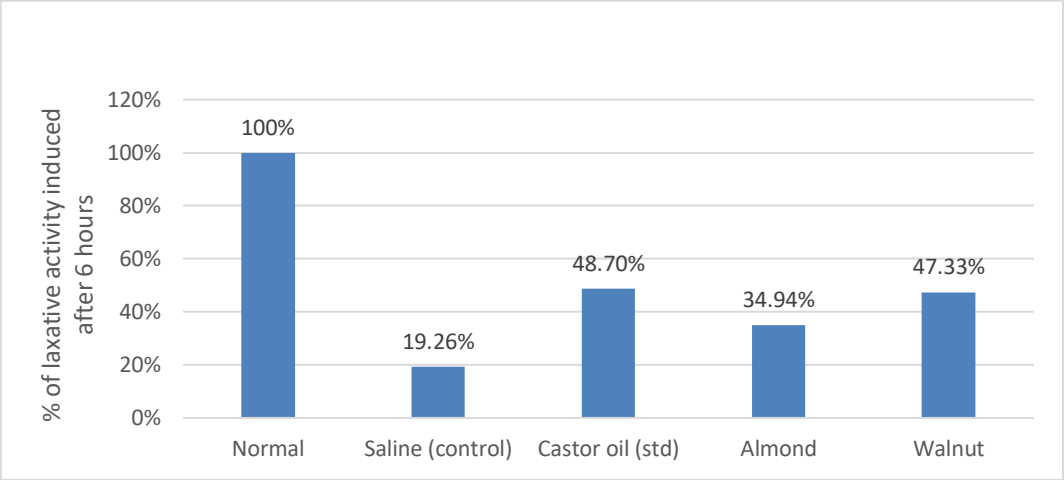


FIGURE : GRAPH SHOWING % OF LAXATIVE ACTIVITY INDUCED AFTER 6 HOURS

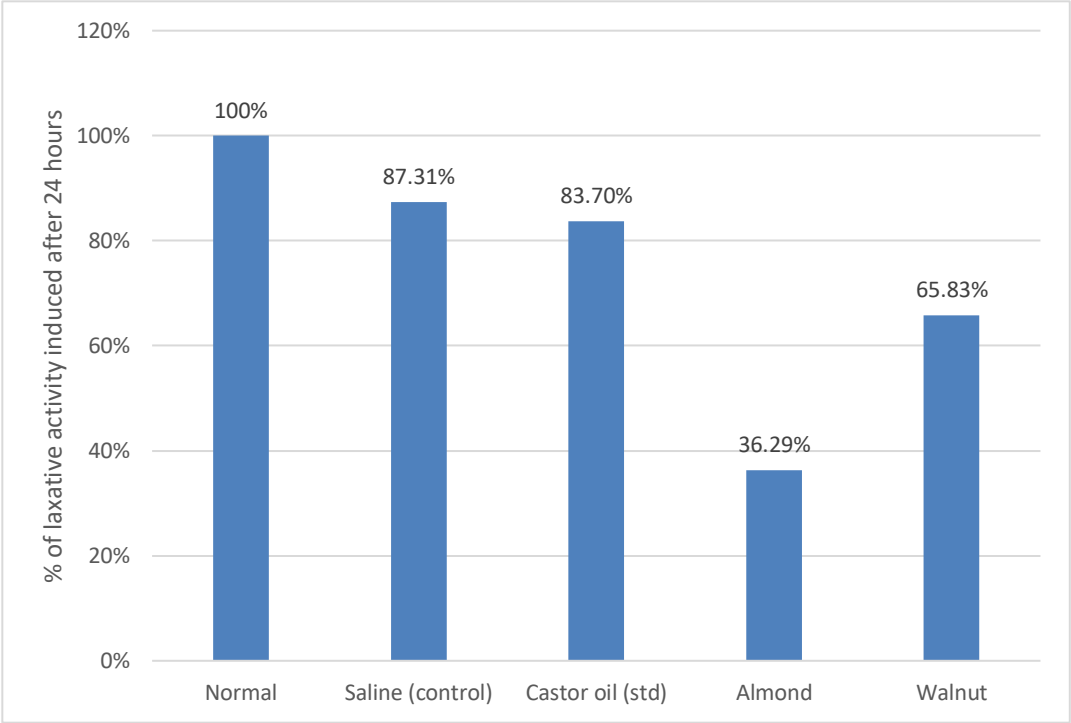


FIGURE: GRAPH SHOWING % OF LAXATIVE ACTIVITY INDUCED AFTER 24 HOURS

DISCUSSION:

- By conducting this experiment (Name) we got to know that fibrous food such as cellulose and other insoluble fibers, are important in preventing constipation.
- Complications of constipation include haemorrhoids and anal fissure, faecal impaction, rectal prolapse and encopresis. The laxative activity of natural foods i.e. dry fruits are studied.
- The order of laxative activity after inducing constipation is observed as follows:
  Walnut(65.83%)>Almond(36.29%)
- Here by, we would like to conclude that "WALNUT" has shown good laxative activity and may treat constipation.

CONCLUSION:

From the above values of crude fiber percentage in different dry fruits it is found that they contains a varying amounts of crude fiber.

The laxative activity of dry fruits i.e.., Prunus dulcis, Juglans regia, Raisins, Anacardium occidentale, Phoenix dactylifera was studied in rats.

The results showed the significant increase in faeces output of the rats. It order of effectiveness of laxation induced by the is as follows Juglans regia, Prunus dulcis, Phoenix dactylifera, Anacardium occidentale, Raisins.

The adequate amount of crude fiber intake has a number of health benefits, including maintenance of healthy laxation and the reduced risk of cardiovascular disease and cancer etc.

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