



Effect of *Citrullus colocynthis* (Bitter Apple Fruit) Feeding on Ruminants' Performance

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Citrullus colocynthis is a nutrient-rich herbaceous plant known for its health benefits. It has many useful properties, including acting as an antioxidant, lowering blood sugar, fighting bacteria and cancer, reducing inflammation and pain, supporting digestion, improving reproductive health, protecting the body, and boosting the immune system. It also has antimicrobial, antidiabetic, cholesterol-lowering, anti-tumour, anti-allergic, pest-repelling, and blood-clot-dissolving effects. It is a useful plant for therapy because of its bioactive components, which include cucurbitacin, flavonoids, and polyphenols. Bitter apple is a herbaceous, annual plant with a rough and irregular stamp. the plant has been used traditionally to treat diabetes, leprosy, the common cold, cough, asthma, bronchitis, jaundice, joint pain, cancer, toothache, wounds, mastitis, and gastrointestinal disorders such as indigestion, constipation, dysentery, gastroenteritis, colic pain, and various microbial infections. Several bioactive chemical constituents of fruits were identified, including glycosides, flavonoids, alkaloids, fatty acids, and essential oils. the plant was also found to be nutritionally beneficial, with high protein content and important minerals, as well as edible seed oil. the plant has enormous potential for use in pharmaceutical and nutraceutical applications, according to critical analysis, with some indications of synergistic and/or side effect-neutralizing combinations of activities. according to a study, bitter apple fruit pulp contains two unidentified naturally occurring substances in addition to isolated choline. In biological processes, alkaloids are thought to have metabolic and developmental roles. these substances, such as steroidal alkaloids, have been used in medical science and appear to have a defensive role in animals.

Origin

India, Pakistan, and the southern islands are among the countries in Asia and Africa that grow bitter apples. The herb is also indigenous to North America, Mediterranean Europe, Afghanistan, Saudi Arabia, Egypt, and Turkey. It grows on sub-desert soils and sandy seacoasts up to 1500 meters above sea level.

Botanical Description

One of the most genetically varied families of food plants is the Cucurbitaceae. This family of plants typically tolerates drought, but they are sensitive to frost and intolerant of moist, poorly drained soils. The bitter apple, gourd, cucumber, melon, and pumpkin are some of the well-known members of this family. Its rough leaves are 5 to 10 cm long. It has a triangular sinus, numerous clefts, and a deep middle lobe with three to seven lobed areas. These leaves appear green from the top, but they are pale from the bottom. Its peduncle-borne, solitary, yellow flowers have five lobed corollas. Fruits have many globular seeds that are 4–10 cm long and have elliptical cracks.

Traditional uses

Cancer, diabetes, bacterial infections, pulmonary, cutaneous, constipation, oedema, and gastrointestinal disorders can all be treated with *C. colocynthis*. For intestinal parasites, gastroenteritis, and indigestion, the dried pulp of the fruit of *C. colocynthis* is used as a treatment. Additionally, ileus, or intestinal paralysis, weak bowel movements, diabetes, and liver issues are all treated with the plant. as an analgesic, the fruit extract is utilised.



(Bitter apple fruit)

Chemical constituents

Albuminoids, glycoside, elaterin, phytosterol, colocynthenin, phytosterols, cucurbitacin B and E, etc.

Proximate composition and mineral contents of *Citrullus colocynthis* seeds.

Proximate composition (g/100 g)

Category	Value
Moisture (%)	4.91
Ash (%)	2.00
Protein (%)	13.19
Fat (%)	18.59
Mineral Composition (mg/100g)	
Calcium	569
Copper	5.1
Iron	11.6
Magnesium	210
Phosphorous	30.0
Potassium	465
Sodium	11.9
Zinc	1.1

Chemical composition of different parts of Colocynth and substrate:

Different parts of the colocynth (*Citrullus colocynthis*) have different chemical compositions. On a dry matter basis, the whole fruit has 8.75% total ash, 17.15% crude protein (CP), 12.15% ether extract (EE), 29.4% cellulose, 55.3% neutral detergent fibre (NDF), 45.8% acid detergent fibre (ADF), and 15.7% acid detergent lignin (ADL). the nutrient levels of the seed and peel are different: the seed has 2.35% total ash, 21.95% CP, 14.8% EE, 30.4% cellulose, 63.7% NDF, and 45.3% ADF, while the peel has 16.0% total ash, 12.9% CP, 8.0% EE, 23.8% cellulose, 38.4% NDF, and 32.2% ADF. Protein content ranges from 13.19% to 26.86%, fat content from 14.48% to 24.62%, and ash content from 2.00% to 4.46%, according to earlier studies.

List of different bioactive compounds present in different parts of bitter apple and their mode of action

Bioactive Compounds	Specific Constituents	Activity	Mode of Action
Flavonoids	Iso-vitexin, iso-orientin, iso-orientin 3'-methylether	Anti-tumor, Anti-inflammatory, Anti-diarrheal	Inhibits the production of prostaglandins and autacoids. Enhances the abnormal water transport across the intestinal mucosa and makes it more regular.
Cucurbitacin	Colocynthisides A, Cucurbitacin B	Anti-cancer, Antimicrobial	characteristics of membrane compression, which include membrane disturbance.

Health benefits and traditional uses of the different parts of bitter apple

Seeds	antidiabetic characteristics
Leaves	They have diuretic qualities. aids in the management of conditions such as asthma. Additionally, it is utilised to treat cancer.
Pulp	beneficial in the management of TB, tumours, anaemia, and throat conditions
Roots	beneficial in the management of rheumatism
Fruit pulp (Dried)	beneficial in the management of gastrointestinal conditions
Fruit extracts	Helps for pain relief and also used to treat diabetes
Seed oil	beneficial in treating constipation
Root paste	used for the treatment of joint pain
Fruit	beneficial in the management of diarrhoea

Effects on Ruminant Performance

1. Feed Intake and Digestibility

Feed expenses decreased while animal performance remained constant. In India, supplementing lactating Rathi cows fed *Lasiurus indicus* grass hay with *Citrullus colocynthis* oil meal, which replaced up to 25% of the concentrate, resulted in a 35% reduction in cattle feed expenses while having no effect on weight gain or milk yield. Every animal was still in good health. *C. colocynthis* seed meal (CCSM) Effects on 270- days-old Male Cobb and the Addition of Feed to Males at the Rates of 0%, 2%, and 4% to 270-days old male Cobb broiler chickens. The addition of 4% improved carcass weight, dressing percentage, and live body weight, but as the level of CCSM incorporation increased, feed intake was negatively affected and the feed conversion ratio worsened. *C. colocynthis* fruit powder is effective in preventing coccidiosis, while higher levels of CCSM improve growth performance but reduce feed intake efficiency. *c. Colocynthis* can help with anti-tumor activity and inhibit the growth of cancer cells. due to colocynthis, decrease blood glucose, which is useful for diabetics. bitter apple fruit pulp extracts help to protect against breast cancer and reduce the growth and spreading of cancer cells. It also works on stopping moving cancer cells from one body part to another, which could be fatal in animals. by fruit pulp control on multiplication of cancer cells. colocynthis oil promotes liver health and improves the activity of antioxidant enzymes.

2. Growth Performance

The most significant bioactive compounds found in bitter apple fruits include alkaloids, glycosides, flavonoids, phenolic acids, saponin, tannins & terpenes. Bioactive compounds from plants could also be used as feed additives for enhancing livestock productivity and reducing environmental pollutants such as methane in the exhaled gas and nitrogen and phosphorus in urine. the extracts of leaves, fruits, roots of various plants containing plant secondary metabolites such as saponins, terpenoids, phenylpropanoids, tannins etc. are traditionally used as medicine are recognized as having antimicrobial and anti-methanogenic properties Saponins have also been known to have several health beneficial effects, for example, enhancement of immunity, reduction in blood glucose and other antidiabetic effects,

and reduction in blood cholesterol. Saponins also have anti-protozoal effects and could potentially be used for controlling protozoal diseases.

3. Reproductive performance

The first factor that determines a sound and profitable animal production system is the animal's reproductive efficiency. Reproductive disorders are one of the main issues lowering dairy animal productivity and production. Inability to reproduce is a process that incurs heavy losses in the livestock industry. Bitter apple fruit have been in use for generations to treat reproductive disorders, and they are still being used today to treat a number of reproductive affections. Bitter apple fruit possess unique therapeutic properties, which can cure a range of reproductive disorders in animals, including anoestrus, repeat breeding, endometritis, retained placenta, and abortions.

Side Effects and Toxicity of *C. colocynthis*

The compound cucurbitacin, which is present in *colocynthis*. Small *cyclocynth* droplets can cause kidney damage, diarrhoea, gastrointestinal distress, irritation, and blood infections in the urinary tract. Additionally, it can be fatal and causes difficulties, such as paralysis in children. The dosage of *cyclocynth* depends on factors like age, health, and cleanliness of the surrounding environment. Not enough information is available to establish a precise *cyclocynth* dosage. The dosage is crucial in any situation where natural products are unsafe. It might be challenging to apply without first speaking with a doctor or chemist. During pregnancy and breastfeeding, *Cyclocynth* should be avoided because it is harmful.

Precautions

Avoid use during pregnancy and breast feeding. It may cause inflammations. The fruits can cause extreme bowel pains and dangerous inflammations. Bitter apples and extracts of these plants should not be administered to children or people having a weak constitution. Consumption of over a gram of the fruits or seeds (dry weight basis) results in intestinal inflammation and rectal bleeding. Lethal dosages (starting at 2 g) lead to convulsions, paralysis and, if untreated, to death through circulatory collapse. Select well-matured fruits without damage. Unripe fruits and seeds should not be used.

Conclusion

Citrullus colocynthis, also referred to as bitter apple, is a remarkable plant that boosts numerous health-protective features and has strong therapeutic potential. The rich profile of bioactivity includes cucurbitacin, flavonoids, glycosides, and saponins, thereby explaining its manifold medicinal applications. It has traditionally been used in the treatment of gastrointestinal disorders, diabetes, respiratory infections, and inflammatory diseases. There are unique health benefits contained in the seeds, pulp, leaves, and roots of this particular plant, which includes antidiabetic and anti-inflammatory activities, diuretic effects, and analgesic properties. Its importance in livestock nutrition promotes feed efficiency and growth performance coupled with improved reproductive health; hence it will be very handy in most sustainable animal production systems. *C. colocynthis* seeds are full of proteins, essential minerals, and oil, which explains their value as both human consumables and stock feeding formulations. Yet, the intense bioactivity possessed by the plant also poses potential toxicity risks, and over-inhalation or incorrect dosages would expose the animals as well as the humans to terrible gastrointestinal distress and hepatotoxicity, renal failure, and possibly death. These toxic effects occur due to strong laxative property and the strong presence of the highly active phytochemicals. Due to its potential toxicity, bitter apple should be used with caution in pregnant or breastfeeding women, children, and people with compromised health. Proper dosing, professional supervision, and avoiding large quantities will ensure safety. Although it is risky, *C. colocynthis* remains a valuable medicinal plant with promising applications in pharmaceuticals, nutraceuticals, and sustainable agriculture, showing its importance in traditional and modern medicine alike.

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