

# Potential of Apple Waste as a non-conventional feed for Livestock and poultry

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## Abstract

Apple (*Malus domestica Borkh*) is one of the most cultivated and consumed tree fruits in the world and is widely grown fruit in Jammu & Kashmir which is considered as apple bowl of country. It is a major horticulture produce and is the backbone of the rural economy of this region. Out of the total production of 1348.15 metric tonnes, its share (%) in the total apple production in the country is 70%. Approximately an amount of 65722.31 metric tonnes of apple pomace is being produced from apple processing industry. This poses a disposal problem, environmental pollution and loss of valuable biomass and nutrients. Apple pomace is a heterogeneous mixture consisting of peel, core, seed, calyx, stem and soft tissues, rich source of fermentable carbohydrate, protein, crude fibre and minerals used for feeding to livestock. Apple pomace has high moisture content, possesses insoluble carbohydrates. (Cellulose, hemicellulose and lignin), reducing sugars (glucose, fructose and sucrose), rich source of minerals and vitamin C. However, it is low in protein and essential amino acids. Typically, apple pomace contains 66.4-78.2% moisture and 9.0-22% carbohydrates. Its value depends mainly on carbohydrates, crude fibre, fermentable sugar, pectin and mineral contents. Being a good source of energy, it can be included in livestock and poultry ration for profitable production.

**Key words:** Apple waste, Livestock feed, Nutritive value

## Introduction

Due to continuous increase in livestock and poultry population and increasing expenditure on feed, it is obligatory to find alternative feed ingredients for feeding them. The use of agri-food waste as a feed additive for livestock means not only supplementation with valuable, unused nutrients, but also the possibility of using cheap nutritional additives, i.e. reducing feed costs and thus production costs. Recycling of agri-food waste in livestock and poultry production is also an important aspect of environmental protection, among others, to reduce the costs of waste disposal and dropping pollution, as it is an effective management strategy to convert waste to wealth. On the other hand, the use of fruit pomace in animal production also has a pro-social dimension—supporting the "zero waste" movement and showing consumers that the ingredients used in animal nutrition are of natural origin. By-products of agricultural origin used in animal nutrition are also an example of rational resource management, because in this

way it is possible to reduce in feed, for example, the share of cereals, which can instead be used as products for humans.

Apple pomace (*Malus domestica Borkh.*) is the solid residue that remains after milling and pressing of apples for cider, apple juice or puree production (Givens et al., 1987; Kafilzadeh et al., 2008). Culled, dropped and damaged apples (broken, injured during plucking, unfit for packing) are available in plenty during the apple season and are sometimes used for feeding livestock (NDDDB, 2012).

Apple pomace contains peel, flesh, stem, core, seeds and juice residues (Sudha et al., 2007; Crawshaw, 2004). A sample of apple pomace was reported to contain 54% pulp, 34% peel, 7% seeds, 4% seed core and 2% stem (Kolodziejczyk et al., 2007). Fresh apple pomace contains 15-30% DM and pressed pomace 30-40% DM. Apple pomace is a multipurpose product with many uses including fuel (ethanol production), direct burning, gasification, anaerobic digestion (methane generation), food (pomace jam, sauce, confectionery products such



as pomace powder for toffees), pectin production, citric acid production, fibre extraction, and livestock feed (Shalini and Gupta., 2010). Apple pomace is used fresh in the vicinity of apple processing plants. Because of its high moisture and high content in fermentable sugars, fresh apple pomace spoils readily and is often ensiled or dehydrated for longer preservation (Shalini and Gupta., 2010; Crawshaw, 2004). Apple pomace is rich in phenolics (i.e., dihydrochalcones, anthocyanins, flavonols, and phenolic acids), accounting for several health benefits (Konrade, et al., 2016). The polyphenolic chemicals included in pomace have been shown to possess antioxidant and anti-inflammatory effects.

India produces 1 million ton of apple pomace yearly, but only 10,000 tons are used as feed (Shalini and Gupta., 2010). Apple pomace can be found in every temperate area where apple trees are grown. Because it spoils easily, apple pomace is mainly used in the vicinity of apple juice or cider plants. Apple pomace is a product that is produced by pressing apples in fruit juice and concentrate factories and account for 25% to 30% of fruit (Fernandes et al., 2022). Apple pomace is an insoluble component of pulp, peel, seeds and stems. In its composition, this pomace has a large amount of carbohydrates, crude fiber and microelements, and little fat (0.7%) (Patocka et al., 2020; Pollini et al., 2021). Pectins contained in apple pomace improve intestinal function and stimulate the intestinal microbiome (Jackson et al., 2022). In apple growing areas, apple can be utilised in animal feeding to reduce the cost of production and also reduces the environmental pollution.

#### Potential uses and nutritional benefits of Apple pomace:

- **Food ingredient:** Apple pomace can be used as a food ingredient to increase the fiber content of enriched products. It can also be used to enhance the nutritional and antioxidant properties of food products, such as Italian salami.
- **Antioxidants:** Apple pomace contains natural antioxidants, such as quercetin glycosides and phloridzin, that can help prevent constipation and hypertension.
- **Dietary fiber:** Apple pomace is a good source of dietary fiber.
- **Waste management:** Apple pomace can help with waste management issues.

- **Biotechnology:** Apple pomace can be used in biotechnology for the production of enzymes, aroma compounds, and organic acids.
- **Cattle feed supplement:** Apple pomace can be used as a supplement for cattle feed.
- **Compost:** Apple pomace can be used as compost.
- **Pectin recovery:** Apple pomace can be used to recover pectin.
- **Extruded snacks:** Apple pomace can be used to make extruded snacks.

Apple pomace is rich in carbohydrates, acids, fibers, minerals, simple sugars, and small amounts of proteins and vitamins.

**Dietary fiber:** Fiber is crucial for digestive health, and apple pomace contains both soluble and insoluble fibers. Soluble fiber can help regulate blood sugar levels and lower cholesterol, while insoluble fiber aids in preventing constipation and maintaining overall gut health.

**Beneficial components of Apple Pomace:** Apple pomace is packed with various bioactive compounds and nutrients, which make it a valuable ingredient for multiple food products and dietary supplements. Some key components of apple pomace include:

**Dietary Fiber:** One of the standout features of apple pomace is its high fiber content. Fiber is crucial for digestive health, and apple pomace contains both soluble and insoluble fibers. Soluble fiber can help regulate blood sugar levels and lower cholesterol, while insoluble fiber aids in preventing constipation and maintaining overall gut health.

**Polyphenols:** Apple pomace is rich in polyphenols, which are antioxidants known for their ability to combat oxidative stress and inflammation in the body. Polyphenols also have the potential to support heart health and may reduce the risk of chronic diseases.

**Vitamins and Minerals:** Apple pomace contains vitamins like vitamin C and vitamin A, as well as minerals like potassium. These are essential for maintaining overall health and well-being.

**Prebiotic Compounds:** Apple pomace contains compounds that can act as prebiotics, which promote the growth of beneficial gut bacteria. A healthy gut microbiome is associated with improved digestion, a strengthened immune system, and potential mental health benefits.

**Table 1. Feeding trials conducted in animals**

Level of incorporation and effects	Species of animals	Authors
Apple pomace could replace in the diet of crossbred cow (Red Sindhi X Jersey) to the extent of 33% without any adverse effect in the quantity and quality of milk produced.	Cattle	Tiwari <i>et al.</i> (2008)
Calves could be raised with 33% substituted maize by apple pomace incorporated diet.	Cattle	Tiwari <i>et al.</i> (1994)
Substitution of maize with 80 per cent apple pomace was no way inferior to that of control	cattle	Narang and Roshanlal (1985)
The finisher male pigs (Yorkshire × Duroc × Landrace) were fed the apple pomace-mixed silage <i>ad libitum</i> had no significant difference in finished body weight, average daily gain, carcass weight, back fat thickness between the control and the Apple Pomace Mixed Silage	Pig	Fang <i>et al.</i> (2016)
In poultry, apple by-products can account for up to 5% in the broiler diet and up to 10% in the laying hen diet to reduce oxidative stress.	Poultry	Azizi <i>et al.</i> (2018)
broiler chickens receiving apple pomace in the diet had no significant effect on body weight at 6 weeks in compared to control.	Poultry	Zafar <i>et al.</i> (2005)
No effect on addition of 5% and 10% apple pulp on the production of laying hens, but at 15% reduced egg weight and laying, and also worsened feed efficiency	Poultry	Ghaemi <i>et al.</i> (2014)
Dietary supplementation with 12% to 20% dried apple pomace reduced feed intake of birds	Poultry	Aghili <i>et al.</i> (2019)

## Conclusion

It is concluded that apple pomace can be used as a feed stuff for livestock with respect to digestible organic matter. Being a good source of energy, it can be included in livestock ration or as a supplement when feeding low quality roughage. This can be source of nonconventional feed ingredient for profitable livestock and poultry production.

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