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ORIGINAL ARTICLE



## Milk and milk Products as Bio-fungicide - A Review

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### ABSTRACT

Farmers can make natural fungicides which would help in plant protection against fungal attack. There are various natural fungicides which can be prepared by the farmer by using everything natural and very low on cost. Milk and its products such as butter milk; they can be used as a natural fungicide to control fungus in various crops. The use of milk spray for diseases like powdery mildew in vegetable crops, Yellow Rust and White Rust in wheat crop and many more has been in use from many decades. But due to synthetic fungicides they lost their identity but now they are again gaining popularity and are showing results as similar as that of sulfur and synthetic chemicals. The milk protein is considered to be the important component in restricting the fungal growth.

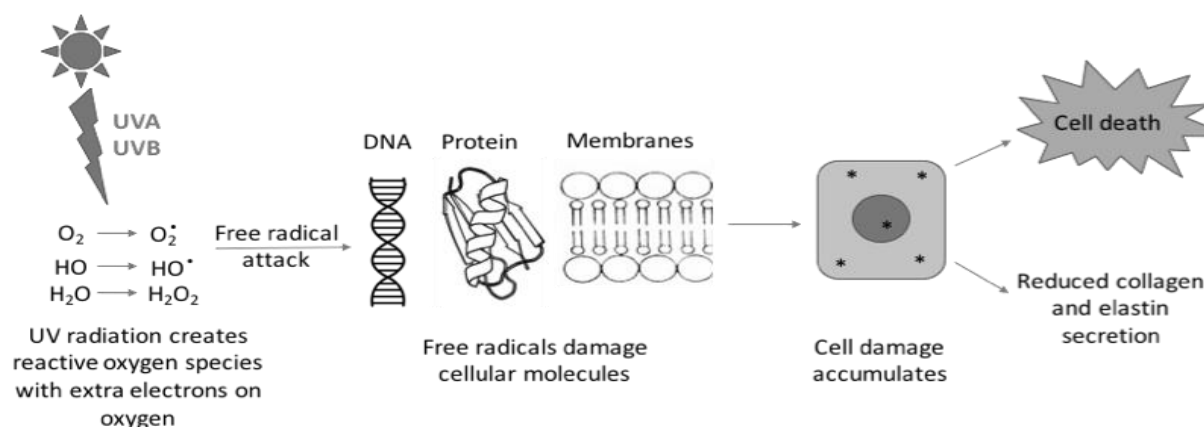
**Key words:** fungicide, milk, whey, Lipid, butter milk

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### MILK

Milk is complex food with high nutritional value and some of its components have antimicrobial and antiviral activity, such as whey proteins and fats. Milk products have used as bio-fungicides since from many decades with varying success, however these products have not been commercialized due to problems such as milk spoilage, handling

difficulties, poor durability of control, and unwanted growth of non-target organisms. The anti-fungal property of milk products makes them a better replacement for synthetic fungicides. Their mode of action has been explained in number of ways. Such as production of free radicals when exposed to UV light, creation of osmotic imbalance due to salts and other components or it might be due to anti-fungal action of the fatty acids. The exposure of milk to ultraviolet radiation in sunlight results in the photogeneration of superoxide anions and oxygen radicals that interfere with the cell membranes of molds such as *Phytophthora infestans* that causes serious potato and tomato disease known as late blight. The production of free radicals when methionine and riboflavin have been exposed to UV light has been shown to control powdery mildew in various vegetable crops. The free radical production in the product can be measured using electron spin resonance spectrometry (ESR).



**Fig 1. Pictorial representation of production of free radicals when exposed to UV light**

Lactoferrin and lactoperoxidase present in milk have been extensively studied as antimicrobial agents largely on species in food spoilage and on fungi related to human health. Lactoferrin is an iron-binding glycoprotein whose concentration ranges from 20 to 200 mg/L in bovine milk and from 56 to 164 mg/L in whey that binds to the membranes of various bacteria and fungi, causing damage to membranes and loss of cytoplasmic fluids. Lactoperoxidase is a known antimicrobial protein present in milk at 30 mg/L. The lactoperoxidase with hydrogen peroxide and thiocyanate has the ability to control *E. coli*, and some other bacteria. However, research into the ability of lactoperoxidase to control fungi appears to be limited.

In 2006, Crisp and his team studied the effect of milk and whey as potential replacements for synthetic fungicides in the control of grapevine powdery mildew disease caused by the fungus *Erysiphe necator*. They reported that various components of milk produced oxygen radicals in natural light which caused the hyphae of *E. necator* to collapse and damaged conidia within 24 h of treatment. Lactoferrin caused rupture of conidia, but damage to hyphae was not evident until 48 h after treatment. The results support the

hypothesis that free radical production and the action of lactoferrin are associated with the control of powdery mildew by milk.

### **LIPID BASED BIO-FUNGICIDE**

A study was conducted on use of lipid based fungicides for powdery mildew (PM) infection which is a major problem for cucurbit growers. The results of the study suggested that anhydrous milk fat (AMF) was the most fungitoxic of all the milk components, with efficacy matching or exceeding that of commercial fungicides (Bravo, and Kumulus). It also had higher efficacy over time and also was not associated with the growth of other non-target microbes. The efficacy of disease control was correlated positively with the percentage of fat content i.e. AMF (99.9% fat) > Cream 70 (70% fat) > Buttermilk (8% fat). However, the AMF treatments were associated with decreased plant health this issue was addressed by using emulsifier (DATEM emulsifier).

### **BUTTER MILK**

The use of buttermilk for its antimicrobial activity in humans and plants has been a traditional practice. Many milk proteins are known to have shown antiviral activity, by inhibiting reverse transcriptase enzyme of viruses.

A study was conducted by a group of scientist at Coimbatore-based Tamil Nadu Agricultural University (TNAU) tobacco Streak Virus which causes cotton necrosis disease in cotton plants. This virus is transmitted through thrips (insect vector) and produces multifarious symptoms and confuses the farmers and hence ends up in applying insecticides to control the vector. In this context they found that a formulation made from a plant growth promoting rhizobacteria called *Bacillus amyloliquefaciens* and butter milk to be more effective against this virus. The Buttermilk was used as a carrier base for application of bacterial inoculation. It was found to effectively colonize rhizosphere and phylloplane of cotton plant and produce anti-microbial peptides and fatty acids, which curbed the virus. This formulation not only reduced the disease but also promoted plant growth and yield.

The Uttar Pradesh is highest sugarcane producing state in india, farmers here are growing 0238 variety plant which has high yield compared to other varieties. But now, farmers find that due to its low immunity, it is prone to diseases like Pokka boeng. Pokka Boeng disease is caused by a complex of fungal species within the genus *Fusarium* that causes malformed or distorted tops in cane crop. It causes the leaves to shrink, dry up and main shoot turns black in colour. This occurs when the crushing stage is due, the use of pesticide at this stage is not advisable as it can affect the quality of sugar and will be harmful for the livestock as the tops of cane crop is used as fodder. The Farmers who used two or three liters of buttermilk mixed in 100 liters of water and sprayed the mixture over the crop found that they were able to control the fungus.

**Preparation method of buttermilk fungicide spray:-**

- Take a plastic or clay pot and put 5 liters of buttermilk and a small piece of copper metal. A small piece of copper metal acts like fungicide and rotting buttermilk.
- Cover the opening of clay pot with polythene. Clay pot should be kept in the shade and also should not be in contact with rain water. Leave the mixture to fermentation for 15 days.
- Filter the mixture of rotten buttermilk after 15 days.
- After 15 days use this mixture on the crops and vegetables.

**How to Use:**

Mix 250 ml-500 ml mixture in 15 liters of water and spray it continuously on crops and vegetables for 4-5 days with the help of foiler-spray.

**CONCLUSION**

Bio-fungicide is one of the best alternatives against chemical fungicides. The limitations to use of bio-fungicides are due to lack of knowledge on the products and their mode of action and use of in vitro antagonism for selection of biological control agents. But, the advantages of this method are more because of their ability to reduce the incidences of disease caused by plant pathogenic fungi. Milk and milk products have been identified to be best anti fungicidal agents mainly butter milk which has a gained popularity in recent years due to its potential to reduce the disease in crop plants.

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