

## Tearless Onions

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### Introduction

Onion is now the world's second most grown vegetable after tomato. The market for low-pungency onions is escalating in the United States and the United Kingdom. The use of low-pungency onions now accounts for 15 % to -25 % of total onion consumption in the United States. Pungency has been correlated with the production of lachrymatory factor (LF) upon cutting or chopping. High pungency and LF-induced tearing generally provide a detrimental experience for consumers who prefer low-pungency types. Onions produce the irritating volatile sulphur compound known as syn-propanethial-S-oxide (allyl sulphate) and release it when ruptured onion cells are exposed to air. It stimulates the eye's lachrymal glands so they release tears.

The lachrymatory sensation is caused by a lachrymatory factor (LF), identified as propanthial S-oxide. The LF had long been believed to be spontaneously produced in the disrupted tissues of the onion from 1-propenyl sulfenic acid (1-PS), a breakdown product of *trans*-(+)-S-1 propenyl-L-cysteine sulfoxide. (PRENCISO) by alliinase. The discovery of lachrymatory factor synthase (LFS), an enzyme obligatorily necessary for converting 1-PS to the LF, raised the possibility of developing tearless onions by suppressing the LFS rather than alliinase. The LFS-suppressed tearless onions are expected to have



additional values because of the availability of 1-PS as a precursor of thiosulfinates, their derivatives associated with the characteristic flavor and the health benefits of onions.

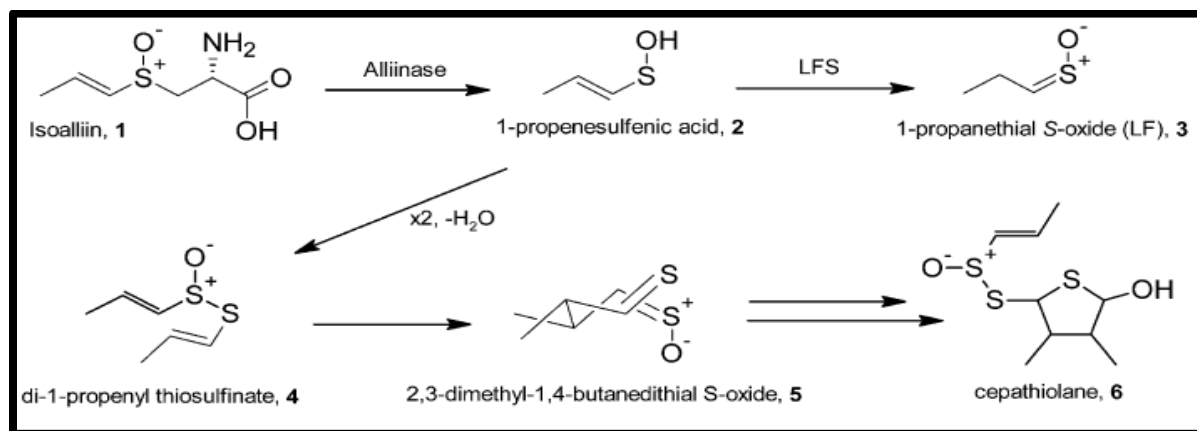
### Why do we need tear-less onions?

Onions are used daily in cooking and are an integral part of numerous dishes; despite this, everyone shies away from cutting onions.

- ✓ There is a huge demand for techniques and tricks to cut onions without tearing up (Wearing sealed goggles with a foam seal, chopping onion under water, chilling the onion)
- ✓ Extreme eye sensitivity to onions
- ✓ Sometimes, onion allergy symptoms may be observed, requiring medical attention.

### Tear-less onions

When LFS-suppressed onion is crushed, it produces increased amounts of thiosulfinates and several compounds called cepathiolanes. In tearless onion, isoallin would be predicted to produce **di-1-propenyl thiosulfinate** instead of propanethial S-oxide. Because the lfs enzyme is suppressed using different technology, resulting in increased thiosulfinates and disulfides.



**Figure 1. The main sulphur pathway following tissue disruption in tearless onions**

In garlic, similar reactions occur as in tearless onions, due to which tearless onions have some attributes and health benefits that are more similar to garlic.

National Onion Association recommends the best method to reduce tearing while cutting an onion, *i.e.*,

- ✓ Chilling the onions for 30 minutes
- ✓ Then, cut off the top and peel the outer layers leaving the root end intact.
- ✓ It is the root end that has the highest concentration of the sulphuric compounds



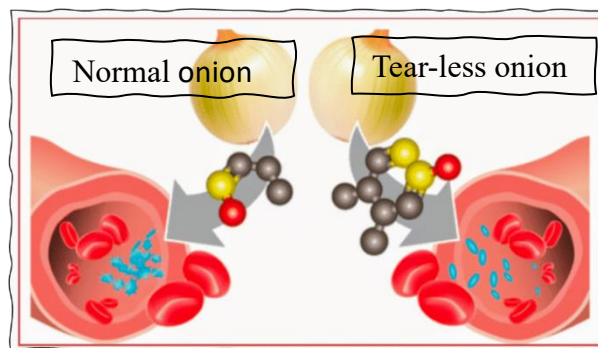
**Some of the other methods include**

- ✓ Using a very sharp knife while cutting onions. Because it causes the least amount of damage to cells
- ✓ Cutting under a kitchen vent/fan
- ✓ Freezing the onion
- ✓ Wearing goggles
- ✓ Soaking the onion under water while cutting
- ✓ Cutting off the base of the onion and throwing it away
- ✓ Microwaving onions before cutting



**Medicinal use of tearless onion**

- ✓ Reduce collagen-induced platelet aggregation
- ✓ Hypocholesterolemic effect
- ✓ Anti-Carcinogenic effect
- ✓ Anti-Asthmatic effect
- ✓ Anti-Pulmonary disorders
- ✓ Anti-Inflammatory effect
- ✓ Inhibit Cox enzyme activity



**Approaches**

Strategies for silencing LFS enzyme activity. There are three approaches to silencing LFS enzyme activity

**A. Gene silencing**

- *lfs*-gene knockout by homologous recombination-dependent gene targeting or mutagenesis
- *lfs*-gene transcript degradation by RNA interference



**B. By irradiating**

- Tearless onions can be produced non-transgenically by irradiating seeds



### C. Growing in sulphur deficient soils

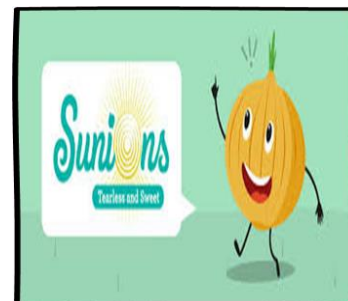
- The onion should be grown in sulphur deficient soils so that they accumulate fewer secondary sulphur metabolites leading to decreased lachrymatory due to allinase mutation



### Achievements

#### Sunions- The onion that will not make you cry

- Sunions were introduced to the world in December 2017, bred by plant breeder Rick Watson
- They are not genetically modified products and were grown through an all-natural cross-breeding program over three decades by selecting less pungent strains of onion and selfing it
- Sunions have a sweet taste, mild flavor and crunchy texture and can be eaten raw
- Sunions become sweeter every day because the amounts of volatile compounds decrease over time
- Pyruvate levels fall from 5-6 to 3 or less during storage



#### Alibaug white onion gets GI tag for health benefits

- White onion of Alibaug in Maharashtra's Raigad district was given GI tag to its unique sweet taste, no-tears factor and for its medicinal properties
- Have low pungency, low pyruvic acid, high protein, fiber & high antioxidant compounds

#### Health benefits

- It boosts immunity
- Helps with insomnia
- Blood cleaning
- Blood pressure
- Heat-related ailments



#### Hindrances

- Reduced antimicrobial, antifungal and wound healing properties along with the reduction in pungency and lachrymatory effect
- Field tests of tearless onions show that they are more prone to diseases and pest
- Currently low, pungency onions have poor storability



## Conclusion

With increasing consumer preference, the future must produce tearless onions to avoid the irritating pungent onion chopping. Gene silencing plays a great role in the production of tearless onion with the use of RNA interference and irradiation with desirable mutagen LFS enzyme inhibition by competition with LFS inactivating protein is another way to achieve the LFS silenced bulbs. We can get tearless onion and chop it happily with the above-mentioned techniques.

