GRAND CHALLENGE

for development of

"Technologies for Primary Processing, Storage and Valorization of Onions"

Vertical 4: Valorization: Value addition and utilisation of utilisation of unconsumed/excess onions

Valorization of onion waste would be alleviating the negative consequences derived from the accumulation of high antioxidant biomolecules, and also provide an economic benefit for both the onion producers and processors. Processing of onion into various ready-to-eat or ready-to-use forms would increase the consumption. Processing of onion into various products like, dehydrated flakes, powder, onion oil, minimally processed onions, onion paste etc. will allow the effective utilization of onions waste.

Onion can be processed into different value added products i.e.

(1) **Minimally processed onions**: These are peeled and/or cut onions for ready to use that retain its freshness, packed in suitable packaging material and stored at refrigerated conditions or frozen conditions.

(2) **Onion paste**: Onion is grounded yet retaining its freshness. Preparation of minimally processed onions and onion paste entails optimization of proper preservatives and packaging materials to increase the shelf life of these products.

(3) **Dehydrated onions:** Dehydration of onions reduces the bulk to transport and also increases the shelf life of onions significantly due to less moisture, which arrests the growth of microorganism. *Use of suitable packaging techniques is the most important to increase the shelf life of dehydrated onion flakes* and powder as these are very hygroscopic in nature.

(4) **Pickles**: Most widely used pickling for onions are vinegar based pickling and oil based pickling.

(5) **Oil**: Onion oil is also used as a natural food preservative in some food products.

(6) **Vinegar/Beverage/Sauce**: As the onions are rich in sugars and other nutrients they can be processed into onion vinegar and onion wine.

Processing of onion into different value added products would reduce the post-harvest losses, and reduce the bulk to transport and cost of transportation. Among the different value added products, dehydrated products have the major demand as they offer convenience, more shelf life, reduction in bulk etc. Dehydrated onions are an important product in world trade and India is the second largest producer of dehydrated onions in the world. India is a major supplier that fulfil the onion demand constituting 89% of global production. The demand for Individually Quick Frozen (IQF) onion is also increasing.

Characteristics of onion varieties for dehydration

1. *Appearance*

   White colour onion is preferred for dehydration due to their appearance and preference in the market.
2. *High Total Soluble Solid (TSS) content*

   Onions with high TSS (18-26%) are most vital attribute for the processing (dehydration). High TSS bulbs will have less moisture for dehydration, requires less energy and needs less dehydration time, which in turn gives white (rather than yellowish) products, give higher product yield, at lower cost of processing.
3. *High pungency (pyruvic acid ≥ 4 $\mu molg^{-1}$)*

   High pungent varieties are preferred for dehydration for better flavor retention after dehydration.
4. *Low ratio of reducing to non-reducing sugar*

   It reduces the discolouration and browning during drying.
5. *Resistance to diseases, moulds and insects*

   Good quality onion with low diseases, moulds and insects both in the field and during storage increases the acceptability of an onion cultivar for processing

   Scope of improvement: The energy requirement is more in processing of onion hence, solar energy based techniques may be encouraged.

Table 12: Value added products available in market with their processing time, process and their market value.

S.No	Product	Market price	Total Market value (worldwide, USD)	Processing time	Process	Scope of improvements
1	Dehydrated onion powder	90-130	208.37 Million	**6-8 hours** (if high humidity, around 80%) or **4-6 hours** (if low humidity)	Dehydration	*Optimization of current designs to reduce the processing time and make the product economical.*
2	Onion rings(Fried)	250	N/A	Fried product (**5 min**.)	Cutting, breading, frying	
3	Onion puree/paste	80 -100	N/A	**8- 10 min**	Milling	
4	Onion salt	540	N/A	Spray drying of onion juice + mixing with salt	Spray drying	
5	Minced onion	70 -90	N/A	**8-10 min**	Dehydration	
6	Onion Juice	70	N/A	**8 -10 min**	Extraction	
7	Pickled onions	110-125	N/A	Pickled onions are a food item consisting of onions pickled in a solution of vinegar and salt, often with other preservatives and flavourings.	Pickling	
8	Onion flakes	115- 128	N/A	**Mincing** of onion and dehydration	Cutting, dehydration	
9	Onion Oleoresin	1200 - 1500	N/A	Onion powder is filled in columns and extracted with various solvents such as Hexene, acetone etc. The total process - **8 hours**.	Solvent extraction	
10	Onion oil	2000 - 2500	40.2 Million	Distillation to extract volatile components. Process time - **4-6 hours**	Distillation	

Table 13: Valorisation potential By-product and utilization of unconsumed/excess onions and challenges

Sl. No.	Valorisation potential	Challenges
1.	Onion drying and dehydration	1. Varietal improvement for high TSS (both white and Red onions) 2. Design and development of energy efficient and low cost drying methods/ machines (solar, hot air mechanized and /or combination of both). 3. Prevention of enzymatic and non- enzymatic browning during drying and storage
2.	Onion paste	1. Prevention of enzymatic and non- enzymatic browning after paste making and during storage 2. Minimizing whipping of paste 3. Improving shelf-life of onion paste
3.	Extraction of potential nutraceuticals/ bio-active compounds of onion	1. Identification and screening of nutraceutical rich onion varieties 2. Identification and /or development of methods for extraction of nutraceuticals 3. Concentration of nutraceuticals/ bio-active compounds 4. Development of nutraceutical rich food products/ functional food with medicinal properties.
4	By-product and waste utilization	1. Use of onion leaves in value added products 2. Use of onion wastes (leaves, peels, spoiled onions, seed husk) in biogas generation 3. Development of edible packaging material from onion waste.