Design and development of protective gear for Chilli destalkers

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Abstract
Destalking of dry chilies is a process followed at the trader’s level to improve the colour and quality of chilli powder. Women are engaged in this manual activity who not only face health issues but encounter injuries to hands and fingers due to the dry prickly stalks of chilies. Information on the period of work, output and health issues were elicited with the help of specially designed questionnaire developed for the purpose. 50 women were involved in the study. The survey results revealed that the destalking operation is done from four to six months in year spending 5-10 hours per day by 44% of them, with an output of more than 6 kg per day by 64%. 82 per cent indicated that they feel burning sensation in hands and fingers which they overcome using fine jute thread to wrap fingers. Sixty per cent had irritation in nostrils due to pungency, pain on fingers (48%), and eye irritation (46%) respectively. Based on these survey results hand gloves were designed different length, using cotton fabric and knitted fabric and in style with quirks and without quirks. Design features were evaluated by the experts for their suitability and glove without quirks received higher response.

Keywords: Chilli destalkers, irritation in nostrils due to pungency, pain on fingers

Introduction
Chilli is one of the prime commercial crops of India. In Andhra Pradesh this crop is being cultivated on commercial basis larger areas with higher yields and revenue. In terms of exports, it stands first among other states. Among thirteen districts of Andhra Pradesh, Guntur is prominent in growing chilli in an area of 66,896 hectares with production of 1.2 lakh tones (Velayyutham and Damodaran, 2015) [4]. Farm men and women are involved right from sowing to harvest and storage of the crop. Among all postproduction operations, destalking is one of the important operations that is done for maintenance of quality and colour of chilli powder. It is this quality that customers see before paying. Apart from this, it also forms a main operation for export of dried chilli pods in précising the space during transport.

In this context, chilli processing units play a prime role at the trader’s end. One can see a greater number of units working in Guntur’s Chilli Market Yard which is Asia’s biggest market yard. Destalking is exclusively done by women in the units manually, with bare hands. A preliminary survey of units gave an insight into their health problems and physical injury due to this repetitive movement without any protection.

According to Dwivedi and Kiran (2013) [1] major problems faced by the workers during threshing are largely related to skin like itching, dry skin, cracks, pimples, and acne. Other physical health problems are pain in shoulder & elbow, stiffness, and tremors in hands. These women opined that if their hands can be protected, it not only helps to prevent injuries by also helps to increase their efficiency of destalking. Padma and Shaik (2017) [3], developed indigenous gadgets to combat health hazards of agricultural workers while harvesting of okra fresh pods, cotton picking, chilli picking, etc. Gandhi et al, (2014) [2] stated that appropriate protective gadgets not only reduce the health hazards, but also increases the output thereby increasing the efficiency of the worker. Hence, protective gloves were developed to overcome physical health problems faced by the women labour while destalking of dried chilli pods in the processing units.

Material and Methods
Physical survey was conducted through personnel interview using a specially designed interview schedules to illicit various problems associated with destalking.
Fifty women who are actively involved in destalking of dried chilli pods were selected for the study. The requirement of women for protection and comfort was also identified with the questionnaire. Based on the filed survey a suitable protective gloves for both hands were developed in ¾th length using thick plain weave cotton fabric (100 GSM) and cotton knitted (150 GSM) fabric.

### Results and Discussion

#### Field survey

Personally visited the chilli processing units located in and around the Guntur. Information pertaining to time and period of their work, precautionary measures if any followed by them during destalking chilli pods in processing units were tabulated (Table 1 & 2). Survey indicated that 44% spend 5-10 hours per day and the turn over capacity was 5-6 kg/day of dried chilli (64%). Eighty two percent of destalkers expressed that feeling of burning/hot sensation on hands, fingers followed by irritation in nostrils due to pungency by 62%, Pain of fingers and hands by 48%, and eye irritation by 46% of them (Table 3).

#### Table 1: Hours of exposure

| Daily exposure duration | N = 50 |
|-------------------------|--------|
| Less than 1 hour        | 4 (8)  |
| 1-5 hours               | 6 (12) |
| 5-10 hours              | 22 (44)|
| More than 10 hours      | 8 (16) |

#### Table 2: Turnover of destalking per day

| S. No. | Turnover per day | N = 50 |
|--------|------------------|--------|
| 1.     | Less than 2 kgs  | 4 (8)  |
| 2.     | 2-4 kgs          | 14 (28)|
| 3.     | 5-6 kgs          | 32 (64)|
| 4.     | More than 6 kgs  |        |

#### Table 3: Type of problems encountered while destalking

| S. No. | Problems encountered                                      | N = 50 |
|--------|----------------------------------------------------------|--------|
| 1.     | Cuts and scars on fingers                                 | 12 (24)|
| 2.     | Pain of fingers and hands                                 | 24 (48)|
| 3.     | Deformation on nails                                     | 4 (8)  |
| 4.     | Minor cracks on the fingers/nails                         | 10 (20)|
| 5.     | Cough due to continuous expose to dry chilli pods         | 12 (24)|
| 6.     | Irritation in nostrils due to pungency                     | 30 (60)|
| 7.     | Feeling of burning/hot sensation on hands, fingers       | 41 (82)|
| 8.     | Burning sensation in eyes and mouth                       | 12 (24)|
| 9.     | Eye irritation                                            | 23 (46)|
| 10.    | Running nose                                              | 17 (34)|

#### Table 4: Type of local measures followed

| S. No. | Protection measures                                      | N = 50 |
|--------|----------------------------------------------------------|--------|
| 1.     | Covering mouth with cloth/towels                          | 9 (18) |
| 2.     | Wrapping fingers with old waste clothing                  | 7 (14) |
| 3.     | Wrapping fingers with "Band-Aid"                          | 9 (18) |
| 4.     | Wrapping fingers with cellophane tape                     | 5 (10) |
| 5.     | Wrapping fingers with fine jute thread (purikosa)         | 20 (40)|

The local measures they were adopted to overcome these problems were wrapping their fingers with fine jute thread (purikosa) 40%, covering mouth with cloth/towels (18%) and wrapping of fingers with Band-Aid (18%) respectively (Table 4).

#### Design, Construction and Evaluation of glove

Based data analysis, four glove designs, two with quirks and two without quirks were developed using two different fabrics. The features of the gloves were evaluated by subject matter experts.

![Palm view and Top view of designed glove](image_url)
By the destalkers without hindering the work efficiency of destalking operation. Further, the developed gloves were evaluated for their performance based on different features of the glove. Among two different lengths designed, $\frac{3}{4}$ length received highest response score by experts. Ninety five per cent and above voted for glove without quirks, and an average of 90% of them have chosen the style of glove with woven fabric on the palm side and knitted cotton fabric on the back of palm side in the glove. In case of gloves with quirks, woven cotton was used in glove while the quirks were added with knitted cotton material. The response scores for this type of glove was below 80% indicating that gloves design without quirks and $\frac{3}{4}$ length of glove were greatly preferred (Table 5 and Fig.1).

### Table 5: Character evaluation of gadget for destalkers

| S. No. | Character                | Response       | Number of persons | Score awarded | Character score % |
|--------|--------------------------|----------------|-------------------|---------------|-------------------|
| 1.     | Glove length             |                |                   |               |                   |
|        | Short                    | Extremely suitable | 25                | 100           |                   |
|        |                          | Very suitable   | 12                | 36            |                   |
|        |                          | Moderately suitable | 5                | 10            |                   |
|        |                          | Slightly suitable | 5                | 5             |                   |
|        |                          | Not at all suitable | 3               | 0             |                   |
|        |                          | Total            | 50                | 151           | 75.5              |
|        | $\frac{3}{4}$th length  | Extremely suitable | 30               | 120           |                   |
|        |                          | Very suitable    | 19                | 57            |                   |
|        |                          | Moderately suitable | 0               | 0             |                   |
|        |                          | Slightly suitable | 0                | 0             |                   |
|        |                          | Not at all suitable | 1              | 0             |                   |
|        |                          | Total            | 50                | 177           | 88.5              |
| 2.     | Glove style              |                |                   |               |                   |
|        | Without quirks           | Extremely suitable | 44               | 176           |                   |
|        |                          | Very suitable    | 4                 | 12            |                   |
|        |                          | Moderately suitable | 1               | 2             |                   |
|        |                          | Slightly suitable | 1                | 1             |                   |
|        |                          | Not at all suitable | 0              | 0             |                   |
|        |                          | Total            | 50                | 191           | 95.5              |
|        | With quirks              | Extremely suitable | 23               | 92            |                   |
|        |                          | Very suitable    | 20                | 60            |                   |
|        |                          | Moderately suitable | 1              | 2             |                   |
|        |                          | Slightly suitable | 0                | 0             |                   |
|        |                          | Not at all suitable | 6              | 0             |                   |
|        |                          | Total            | 50                | 154           | 77                |
| 3.     | Glove without quirks     |                |                   |               |                   |
|        | Cotton fabric on the palm side | Extremely suitable | 40          | 160           |                   |
|        |                          | Very suitable    | 7                 | 21            |                   |
|        |                          | Moderately suitable | 2               | 4             |                   |
|        |                          | Slightly suitable | 1                | 1             |                   |
|        |                          | Not at all suitable | 0              | 0             |                   |
|        |                          | Total            | 50                | 186           | 93                |
|        | Knitted fabric on the back of palm | Extremely suitable | 36         | 144           |                   |
|        |                          | Very suitable    | 8                 | 24            |                   |
|        |                          | Moderately suitable | 4               | 8             |                   |
|        |                          | Slightly suitable | 1                | 1             |                   |
|        |                          | Not at all suitable | 1              | 0             |                   |
|        |                          | Total            | 50                | 177           | 88                |
| 4.     | Glove with quirks        |                |                   |               |                   |
|        | Woven cotton for glove   | Extremely suitable | 23          | 92            |                   |
|        |                          | Very suitable    | 20                | 60            |                   |
|        |                          | Moderately suitable | 1              | 2             |                   |
|        |                          | Slightly suitable | 0                | 0             |                   |
|        |                          | Not at all suitable | 6              | 0             |                   |
|        |                          | Total            | 50                | 154           | 77                |
|        | Knitted fabric for quirks| Extremely suitable | 33          | 132           |                   |
|        |                          | Very suitable    | 6                 | 18            |                   |
|        |                          | Moderately suitable | 1              | 2             |                   |
|        |                          | Slightly suitable | 6                | 6             |                   |
|        |                          | Not at all suitable | 4              | 0             |                   |
|        |                          | Total            | 50                | 158           | 79%               |

**Conclusion**

From the above study it can be suggested that glove with thick cotton fabric and knitted material in $\frac{3}{4}$ length was most sought after as the knitted fabric is flexible and helps to move the fingers easily and the cotton fabric can give good grip when holding the pods to destalk.
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