International Journal of Home Science

ISSN: 2395-7476
IJHS 2015; 1(3): 09-12

www.homesciencejournal.com
Received: 23-06-2015
Accepted: 25-07-2015

D Krishna Priya
Department of Resource Management and Consumer Sciences, College of Home Science, Acharya N.G. Ranga Agricultural University, Hyderabad -500 004

Y Vijaya Lakshmi
Department of Resource Management and Consumer Sciences, College of Home Science, Acharya N.G. Ranga Agricultural University, Hyderabad -500 004

Correspondence
D Krishna Priya
Department of Resource Management and Consumer Sciences, College of Home Science, Acharya N.G. Ranga Agricultural University, Hyderabad -500 004

Designing of a Model Sugarcane Juice Vending Workstation

D Krishna Priya, Y Vijaya Lakshmi

Abstract
Sugarcane juice is the widely consumed juice by most of the people in India which is served fresh as well as stored in the containers for future use. The juice extraction is by different types of machines available in the market where some are having inbuilt workstation and some are placed on the workstation. The work station is the place for the vendor to work and extract the juice. This study was focused on the extraction Sugarcane juice manually and the problems faced by the vendors during the extraction of juice. The vendors faced pain in their body parts viz., shoulders, wrist, arms, and neck due to the improper height of the workstations on which they are working. Increase in the height of the workstation, providing waste bin at the reachable height, providing flip to the machine so that the hand injuries are some of the improvised design features of the workstation so that the injuries can be avoided during the juice extraction.

Keywords: Sugarcane juice, Workstation, Problems, Injuries, Designing

Introduction
Sugarcane crop is widely grown in tropical countries. India is the 2nd largest producer of sugarcane. As the production of sugarcane is high in India the consumption of sugarcane is also equally high, but in different forms. It is rich in calcium, chromium, cobalt, copper, magnesium, manganese, phosphorous, potassium and zinc. It also contains iron and vitamins A, C, B1, B2, B3, B5, and B6, plus a high concentration of phytonutrients (including chlorophyll), antioxidants, proteins, soluble fiber and numerous other health supportive compounds. Sugarcane juice extraction from sugarcane has been adopted by many people as their occupation. Sugarcane juice extraction involves manual work of the vendor where their upper limb of the body is mostly involved in work. As the vendors spend more amount of time at the sugarcane vending workstations, there is necessary to study on the existing machines and designs of workstations which has great impact on the health of the vendor. The workstation that is designed for the juice extraction is not ergonomically designed. The workstation is not suitable for every worker to work comfortably. The vendors make their own adjustment to make the workstation comfortable.
Over the past few years, many research articles were written on the ergonomic factors of different workstations. But the sugarcane juice workstation had not been studied in detail where the vendors of the sugarcane juice were facing many health related problems which lead to musculoskeletal disorders over a period of time. Musculoskeletal disorders are the most important problems that are faced by the workers who are having intensive manual work.

Objectives
- To explore the different existing designs of the sugarcane juice vending machines.
- To explore the functions that is performed by the vendor near the workstation.
- Designing of a model sugarcane juice vending cart workstation

Though many types of machines were available in the market, all were not used by the vendors. So an exploratory research study had been conducted in Hyderabad city to explore different types of sugarcane juice machines that were used in the city by different juice extractors. The data was collected from each and every juice extractor who was having different types of sugarcane juice machines. RULA (Rapid Upper Limb Assessment) was used to assess the discomfort caused in the upper limb of the vendor's body. From the survey it was explored that there are three types of sugarcane juice machines that were used for the extraction of juice from the sugarcane in Hyderabad city.

1. Table top two roller extractor
2. Sugarcane juice extracting machine (Instant cooling)
3. Table Top Sugarcane Manual Trendy Juicer

Hari, A.K (2012) [2] opportunities of making sugarcane juice with latest technology machines was published which reduces the loss to sugarcane farmers. In Hyderabad city they had introduced some machines into the market for the non job youth to have their own unit. The machine that was discussed in this article was "Instant Cooling Sugarcane Juice Machine" which was having following features: instant cooling, no need of large space to establish this unit, easy to operate, easy to clean, noiseless machine, body is of stainless steel, runs on1H.V.motor, inbuilt compressor, no dirt.

Various Functions Performed By the Vendors

The different functions performed by the vendor to extract the juice from the sugarcane are as follows:

Purchasing of sugarcane

Sizing the sugarcane for storage

Feeding the sugarcane

Extracting juice from sugarcane

Straining juice into glass

Serving the juice

While extracting the juice, lime and ginger is also added to the cane to add flavor and taste. The vendors also add ice to the juice to make it chilled.

Different case studies were conducted on each of the machine vendors to know about the feature of the machine and workstation, to analyze the problems of the machines and vendors working at the workstation to conduct ergonomic evaluation of workstation. Munir *et al*. (2012) [3] examined the occupational health of the people who were working in the sugarcane industry and found that 15 to 20 per cent were injured while working.

General Problems Faced By the Vendors

The general problems faced by the vendors who were who were using different workstations are:

1. Shoulder pain due to applying more force to feed the machine with Sugarcane.
2. Bursitis due to sever twisting of wrist while feeding the machine with Sugarcane.
3. Back pain due to continuous standing for long duration.
4. Arm pain
5. Neck pain
6. Severe accidents like hand getting injured while feeding the sugarcane to the machine.
7. Improper height of the workstation.

The vendor who were using 2- roller mechanized machine and manual trendy juicer were facing more problems than the vendor who is using sugarcane cane juice extractor because the vendor have to exert more force to feed the machine with sugarcane

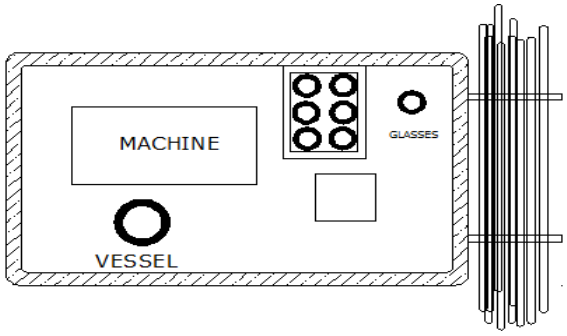
David *et al* (2001) [1] studied on Knowledge, attitude, and practice of sugarcane crushers towards hand injury prevention strategies in India. In this study they have studied on hand injuries of 32 sugarcane vendors as the occupational injury where 63% of injuries were due to carelessness, Sixteen per cent felt that machines with improved safety features are required; 40% supported the use of special gloves, although 19% considered them a hindrance. Eighty eight per cent did not consider the long duration of work as a risk factor and 38% were fatalistic and 50% thought the injuries were due to "bad luck".

Suggestions Given By Respondents

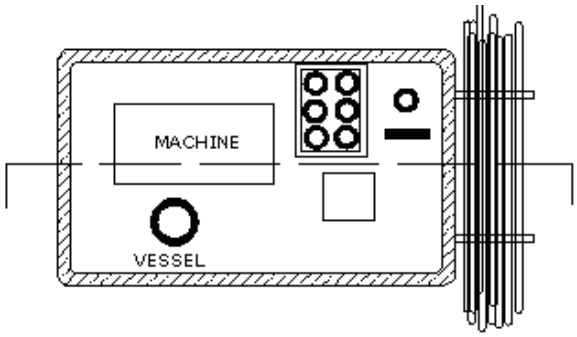
- Height of the workstation should be low
- Providing flip to the machine so that the hand of the vendor will not go into the machine.
- Provision for having waste
- More space for storage.

Design of Existing Sugarcane Juice Machine Workstation

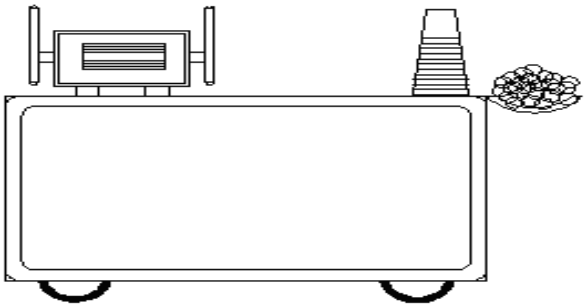
Length of the workstation: 3'6"
Extended length for the sugarcane storage: 1'6"
Width of the workstation: 2'6"
Height of the workstation: 3'



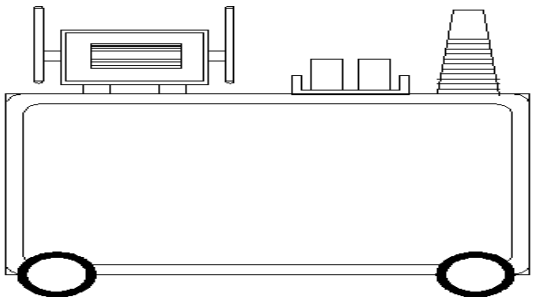
Floor plan of existing workstation



Section of existing workstation



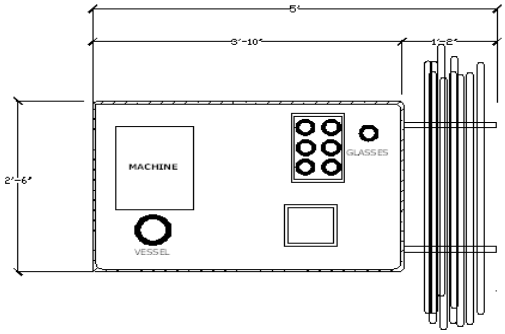
Front Elevation of existing workstation



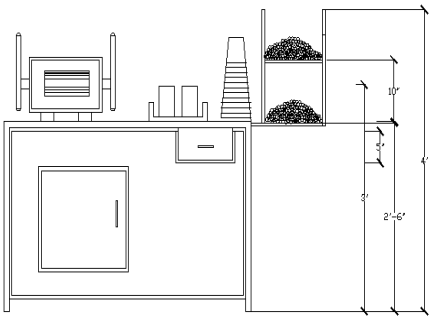
Rear elevation of existing workstation

Design Features That Are Incorporated

1. Standard height of the work station depending on the anthropometric measurement of the human body.
2. Providing a plastic strap to the machine in front of the rollers so that while feeding the machine this strap stops hand injuries.
3. Provision of step storage to the side of the machine so that the vendor can store more sugarcane.
4. Motor to be placed inside the storage space to reduce accidents that the space can be considered accidents can be prevented.

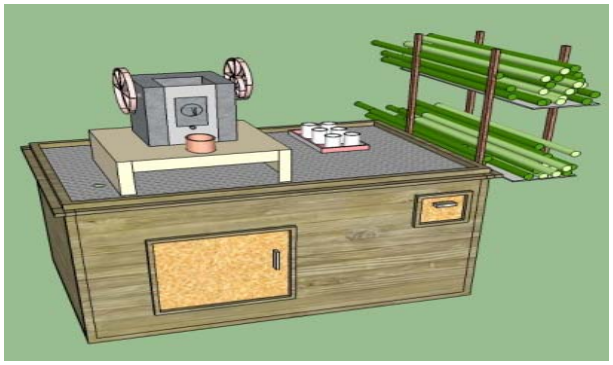


Floor plan of proposed design



Elevation of proposed design

3-D View of the Proposed Workstation



Safety Measures to Prevent Injuries To Hand

The first step in eliminating hazards to the hands, and wrists is education. The employees need to be informed of the proper way to operate a machine like areas not to touch on the machinery without gloves, as well as proper placement of the hands to ensure they are not injured and what to do in case there is a problem. This could include proper instruction on another way in which hazards can be eliminated is to have the

facility inspected privately to determine areas, which might be a hazardous to the worker, and increases their risk of receiving injury to the hand. Rigger style leather gloves are useful for the vendor to handle the work in safe position which is thick enough to handle the work. They even have the tight fitting at the wrist where they can place the glove in position.

Conclusion

The study was conducted to design an ergonomic model which suits the anthropometry of the sugarcane juice vendor and to prevent the occupational health disorders. A survey was done and information was collected and comprehended to design a workstation with the suggestions given by the vendor. The workstation was designed and safety measures to prevent the hand injuries were recommended in the study.

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