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Quality management and post harvest processing in citrus-A review

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ABSTRACT

So far little and most likely no previous study had tried to investigate the relationship between Total Quality Management (TQM) practices and organizational performance particularly in post harvest processing of Indian citrus industry. Implementation of quality management in post harvest processing of citrus may take longer time to implement, and requires major changes in cultural aspects as well as stake holder mindset in citrus industry. Leadership, management, finance, organizational culture, skills and expertise are considered as the generic factors critical for the successful implementation within SMEs environment like citrus industry. Judgmental process of grouping similar requirements led to the classification of all these requirements into ten separate categories. Items identified for the purpose of measuring the performance of post harvest processing aspect and the items were clubbed in four categories. In this review paper several new critical factors pertinent to citrus industry have been identified and basic explanation has been provided, which may help in successful implementation of Quality management and contribute to the success of the citrus processing entity.

Key words: Citrus fruits, Critical success factors, Quality management, Performance, Post harvest.

Horticultural crops have an important place in the agricultural economy of the Asia-Pacific countries. The region grows a large variety of horticultural crops that collectively constitute more than half of the total world production. In addition, most of these countries have for the past several years, maintained positive growth in production indicating the increasing role that horticultural crops play in enhancing farmer incomes, alleviating poverty and improving quality of diet. It is expected that the demand for both fresh and processed horticultural produce will continue to expand in line with the rise in per capita income, better standards of living and increasing awareness of their health benefits (APCoAB, 2010).

In India, citrus is one of the very important fruit crop, after mango and banana both in acreage and production. Keeping in view that the resource required to conserve the harvested fruits are much less than to produce same quantity, about 15-20% produce can be made available for consumption at much less input cost. In a developing country like India, post-harvest losses of citrus fruits are in the range of 25-30% as against 5-10% in developed citrus growing countries like Brazil, USA, Australia, Spain, Italy and Israel (Sonkar *et al*., 2008).

Quality of citrus fruits can be improved by identifying critical success factors and focusing on quality management. Post- harvest losses are enormous due to improper method of harvesting, unscientific handling, packaging and transport of fruits to the distant markets, which are the major problems. Increasing global competition and more demanding customers force companies to seek continuous improvement, and enhanced quality. Hence, organizations employ quality practices such as statistical process control, Six Sigma or the ISO 9000 standards (Talib *et al*., 2011). Quality, quality practices and total quality management (TQM) has received attention from practitioners and scholar's worldwide (Sila and Ebrahimpour, 2003).

It is found from literature that organizations with excellent quality have higher operating incomes revenues and stock performances (Beer, 2003). Companies that can deliver quality are the ones that will be able to compete on the globalization era (Nkechi Eugenia, 2009). Studies show that these factors have a positive influence on firm performance (Ebrahimi and Sadeghi, 2014). Several researchers have also suggested some instruments for measurement of CSFs. Even though finding and selecting adequate instruments for measurement is a major challenge to companies (Salaheldin, 2009).

Quality management: Universally accepted definition for quality is many and depending on the industry it may be expressed in terms of its relevance (Sila and Ebrahimpour, 2003). Quality management evolved from a result-orientated quality control to an integrated company-wide approach (Mehra *et al*., 2001). The concept of TQM consists of three components (Ho, 1997). Total Quality Management (TQM) is a holistic quality management approach that considers the entire value chain and emphasizes human factors (Demirbag

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et al. 2006; Welikala and Sohal, 2008). Ana *et al*., (2005) in their review paper explained model for evaluating organizational competencies and application in the Context of a Quality Management Initiative.

Critical success factors (CSF's): This situation demands immediate attention to improve the quality perception of the food-processing industry, particularly of the small and medium enterprises (SMEs) that constitute a large proportion of the industry in the region. Daniel, (1961) first introduced the concept of key factors. So, CSFs are best practices, input item enablers, which drive a company's success (Baidoun, 2003; Sila and Ebrahimpour, 2005; Soltani *et al*., 2005). The CSFs as initial inputs, which affect the adoption of quality management practices in a critical way (Baidoun, 2003; Salaheldin, 2009; Claver *et al*.,2003; Tarí,2005).

A multitude of different CSFs exist that impact the success or failure of TQM implementation (Soltani, Lai, and Gharneh, 2005; Salaheldin, 2009). Some researchers employed less than four of these CSFs to capture TQM practices and others more than 10 CSFs (Nair, 2006; Wu and Zhang, 2013; Rad, 2006; Black and Porter, 1996).

Saraph *et al*.,(1989), Ahire *et al*, (1996) and Fotopoulos *et al*.(2009) developed a reliable instrument to measure quality management practice, like role of divisional top management and quality policy, Role of quality department, Training, Product/service design, Supplier quality management, Process management operating Quality, data and reporting, Employee relations etc. Karuppusami and Gandhinathan, (2006), Prajogo and Sohal, (2006), Sila and Ebrahimpour, (2002) and Singh and Smith, (2006) recommended that further concern should be made for the evaluation of critical success factors of TQM.

The literature review conducted extensively at the initial stages of this research, demonstrated the existence of gaps in knowledge for the successful implementation of quality management within citrus processing units. The authors attempted to review descriptive, empirical studies conducted by various researchers. The study helped in mapping and assessment of scientific literature and leads to a synthesis of findings, as well as managerial implications and further research opportunities (Tranfield, Denyer, and Smart, 2003).

The authors gone through potentially relevant research through a structured search based on a combination of the keywords 'total quality management, Critical success factors, citrus fruit quality and Post harvest quality management, as well as 'instrument' in the databases.

The article had used post harvest quality management on citrus and critical factors explicitly. The article was based on a quantitative study that develops or applies an item-based measurement instrument to quantify CSFs.

Organizational requirements for effective citrus fruit quality management practices were generated from the literatures that represent different measurements of quality and productivity improvement approaches. Judgmental process of grouping similar requirements led to the classification of all these requirements into 10 separate categories. Items identified for the purpose of measuring the performance of post harvest processing aspect and the items were clubbed in to four categories as per Economic performance, Quality performance, Non financial performance and Innovation and technology performance respectively.

Key elements in post harvest processing for quality management: Silaand Ebrahimpour , (2005) and Tari *et al*. (2005) found that the leadership play a significant role in shaping the quality focus of the companies. Management leadership is necessary for TQM effectiveness because leadership is directly related to quality planning, human resources management, information management, quality assurance, learning, supplier focus and customer focus. Apart from this there are quality management constructs which are

Table 1: List of attributes or input variables and source supporting content validity (Independent variables)

Attributes/Variables	References
Pre-harvest factors	Barret, *et.al*.,(2005); Ladaniya, (2008)
Intrinsic and physical condition	Barret, *et.al*.,(2005); Ladaniya, (2008); Augusti *et al*.,(2002)
Business environment and resources	Yasser Al-Zamani (2002);Schein (2004); Corbett and Rastrick, (2000)
Post harvest pest and disease control measures	Barret,*et.al*,(2005), Ladaniya, (2008), Aquino *et.al* (2011)Wilma du Plooya, (2009),Yoav, (2000), Ismail and Zang, (2004), Irtwange, S.V., (2008); Sharma *et al.,* (2009)
Post harvest process control	Barret ,*et al*.,(2005)
Transportation and storage	Kader and Arpaia, (2002); Barret *et al*.,(2005), Dhall, R.K *et.al.,* (2014); Ladaniya, (2008)
Evaluation/Testing/ Documentation/ auditing factors	Zhang *et al*.,(2000); Judith. A. Abbott, (1999); Sarah Caffyn, (1999); Bessant, J, (1992)
Marketing and Distribution	APCoAB, (2010); Danielly and Adiel, (2012)
Specific Post-harvest Techniques to enhance quality	Verma and Tikoo, (2004); Wills *et.al*.,(1999), Ladania, M.S, (2008); Barret *et.al*., (2005)
Socio -cultural aspects on quality	Barret *et al.,* (2005), Eckes, (2000)

exclusively cater to post-harvest quality management of citrus fruit industry. The constructs as derived from literature is given in Table 1 are explained below.

Pre-harvest factors: The developing stage of fruits is subjected to many internal and external influences, which may modify its inherent anatomical, chemical, and physical characteristics and physiological behavior to some extent (Ladaniya, 2008). The genetic factors, agro techniques, biological control agents and other cultural practices, pre-harvest disease control measures and hygiene and sanitation are some of the factors did affect the composition and quality (Barret, *et al*, 2005).

Intrinsic and physical condition: Quality of fruits can be judged by its edible and other characteristics like nutritional parameters, physico-chemical properties (Augusti, M. *et al.*, 2002; Barret *et al.*,2005). Physical condition of the fruits without bruises and injury will be most suitable for consumption and packaging (Ladaniya, 2008).

Business environment and resources: Government to provide funds for the development of food industry and also to provide support to conducting consumer awareness programmes (Yasser Al-Zamani, 2002). All the employees within the organization are considered as internal customers and should be well satisfied before external customers. The degree of specialized knowledge of customers, suppliers, service providers and availability of skilled labour pool create conducive business environment. Information and communication technology immensely helped in citrus quality management. Lamuka, (2014) pointed out that increasing incomes, urbanization, literacy, and closer ties to global trends have resulted in domestic consumer-based concerns about food safety.

Prodromos *et al*., (2015), in a study proposes a multidimensional conceptual framework, including "customers' demand", "ISO adoption", "operation efficiency", "market efficiency" and "overall financial performance" for quality management. Need of stratified measures and policies to support companies in the fresh produce chain in designing and operating their FSMSs (Kirezieva *et al*., 2015). Supply Chain Management (SCM) of perishable food produce is complex as compared to other SCMs due to the perishable nature of the produce, high fluctuations in demand and prices, increasing consumer concerns for food safety and quality (Vorst and Beulens, 2002), and dependence on climate conditions (Salin, 1998). Adequate infrastructure helps farmers and agri businessman to run their business successfully and helps to deliver the goods in the right time with right condition. Processing and value addition issues, Post harvest loss issues, market demand and information issues are also important in SCM and quality management (Negi and Anand, 2015). The deterioration of water quality is considered to be the most serious threat to water resources and agriculture is one of the major contributors to this problem (Le Roux *et al.,*2015).

Post harvest pest and disease control measures: Infection and contamination occur at different stages in the field and after harvest during marketing (Ladaniya M.S., 2008; Barret, *et.al*., 2005; Jiuxu and Timmer, 2007; Susan *et al*., 2004). Application of essential oil amended coatings to citrus was undertaken by some researchers as a safe botanical preservative against post- harvest fungal infestation of food commodities (Wilma du Plooya, *et al.*, 2009; Ashok Kumar *et al.,* 2008). Integrated pest management strategy and alternative strategies must be used in order to reduce the incidence of fruit fly infestation (Yoav, *et al*., 2000; Simon, 2008; Sharma, *et al.*, 2009; Aquino *et al*, 2011). It has been estimated that without use of fungicides, sale of fresh citrus would be reduced by at least 50% (Ismail and Zhang, 2004).

Post- harvest process control: Harvesting methods may determined uniformity of maturity at harvest, which intern influences quality of the fruit (Barret, *et.al*.,2005).Packing-house are meant for applying suitable treatments and grading of fruit in order to facilitate distribution of fresh citrus as per consumer demand. The sanitation in packinghouses and eco-friendly, healthy alternative to post-harvest chemical treatments are needed with changing times.

Inspection, quality evaluation with labeling will help in proper post harvest process control. Previous researchers, Chen and Nussinovitch (2001); Rong Zenga, (2012); Po-Jung Chien, *et al*.,(2007) studied the effect of coatings on fruit surface for improving post harvest quality. Tiwari and Cummins, (2011) studied the Factors influencing levels of phytochemicals in selected Fruit and Vegetables during pre- and post-harvest food processing operations.

Transportation and storage: Citrus is generally characterized as less perishable fruit as compared to loquat, lychee, fresh fig and mango (Kader and Arpaia, 2002). All the operations like packaging, transportation, temperature and humidity management (Barret, *et al.*, 2005; Ladaniya, 2008; Anung and Chang, 2014) during the operations will influence the storage life. Nagpur Mandarin fruits with minimum handling, packaging and transportation CFB boxes, retains freshness and firmness (Dhall, *et al.*, Ladaniya, 2008, Henriod, 2006, Robert, 1999).

Andrea *et.al*.,(2005) and Angelique (2009) found that commercial conditioning and cold quarantine storage treatments on fruit quality of 'Rouge La Toma' grapefruit and 'Palmer Navel' sweet orange enhanced the shelf life of fruits. Low-temperature cold shock may induce rind colour development of 'Nules Clementine' mandarin (Citrus reticulata Blanco) fruit Graham *et al*., (2006). Storage temperature and time influences sensory quality of mandarins by altering soluble solids, acidity and aroma volatile composition (David Obenlanda, *et al.*,(2011). Ahmet *et*

al.,(2009) studied the effects of hot water treatments on chilling injury and cold storage of fuyu persimmons. Taste and aroma of stored mandarins was compared with fresh by Zipora, *et al*., (2010) in a review paper.

Evaluation, testing, documentation and auditing factors: The aim of the formal evaluation is to provide a starting point for the understanding of quality issues and the identification of areas to improve (Zhang *et al.,* 2000). José and Carlos, (2010) studied intact orange quality prediction with two portable NIR spectrometers as a non destructive testing method. Ricoa, *et al*.,(2007) spelled out the ways to extending and measuring the quality of fresh-cut fruit and vegetables.

Instrumental measurements are often preferred to sensory evaluations in research and commercial situations because they reduce variations in judgment among individuals and can provide a common language among researchers, industry and consumers (Judith, 1999).

The computers simplify database management and accelerate data analysis such as trend analysis (Frederick, 1994). Statistical methods are used for data reduction as the selection of measurement variables, such as wavelength, for predicting quality and for product classification (Judith, 1999, Leena, 2010, Blasso, 2007).The Audit or check may help the firm to monitor the further progress with continuous improvement (CI) (Sarah Caffyn,1999; Bessant, 1992).

Marketing and distribution: Technological changes in the handling of fresh commodities are slow to be accepted by shippers, wholesalers and retailers. Researchers need to develop data that involves simulated shipping tests and commercial trials (APCoAB, 2010). Supply chain logistics, postharvest management and diverse sourcing of fruits and vegetables have brought enhanced concern for food safety.

All innovations and application of technology needed to ensure market access for growers and shippers should be integrated and optimized into the handling system. Another case study adopted a Multi criteria Decision Aid (MCDA) method (Danielly and Adiel 2012) to study the market dynamics.

Specific Post-harvest Techniques to enhance quality: Technological developments are taking place with leaps and strides for making availability of quality fruits for a longer period. Proper harvesting and postharvest management, faulty storage techniques, which permit slow gas exchange leading to spoilage (Verma and Tikoo, 2004, Wills *et al*.,1999, Ladaniya, 2008). The advancements in machine vision, non-destructive techniques for quality determination and real time computer application ensure work efficiency and quality fruit to consumers (Studman ,2001; José and Carlos 2010; Leena, 2010; Blasso, 2007). Fruit coating with fungicide and emulsion, controlled atmospheric storage and modified atmospheric storage are some of the techniques which are used to extend the shelf life of fresh fruits (Barret, *et.al*, 2005; Sandhya,2010; Ron *et al*., 2004;Rong Zenga,(2012),Chen and Nussinovitch 2001). Pre-cooling techniques and applications for horticultural products enhanced the shelf life as confirmed by many researchers (Tadhg and Da-Wen, 2001).

Socio-cultural aspects on quality: The culture can be described as the beliefs which pervade the organization regarding the procedures used to conduct the business and how the employees should behave and the way they prefer to be treated (Corbett and Rastrick, 2000). In recent decades, food safety has become a significant issue (Barret, *et al*,

Table 2: Performance measures proposed by literature and source supporting content validity (Dependent variables)

Source	Measure	Dependent Variables
Lakhal, (2006)	Economic performance	✓ Financial Performance ✓ Operational performance: Profitability, Productivity, Local/ Regional/ global growth
Brah *et al*.,(2002); Tari *et al*.,(2007);	Quality performance/	✓ Product/service quality ✓ Fruit Quality
Barret,*et.al*.,(2005); Ladaniya, (2008)	Quality outcome	✓ Reduction in waste fruits ✓ Employee and service ✓ quality ✓ Process quality ✓ Supplier quality
Tari *et al*.,(2007) Feng *et al*.,(2008)	Non financial performance Organizational Performance	✓ Customer result ✓ People result ✓ Operational performance ✓ Business performance ✓ Reputation ✓ Improved relationship
Su et al. , (2008); Barret,*et.al.* ,(2005): Ladaniya, (2008)	Innovation and Technology performance Organizational performance	✓ Quality performance ✓ Business performance ✓ RandD performance ✓ Value creation due to new technologies

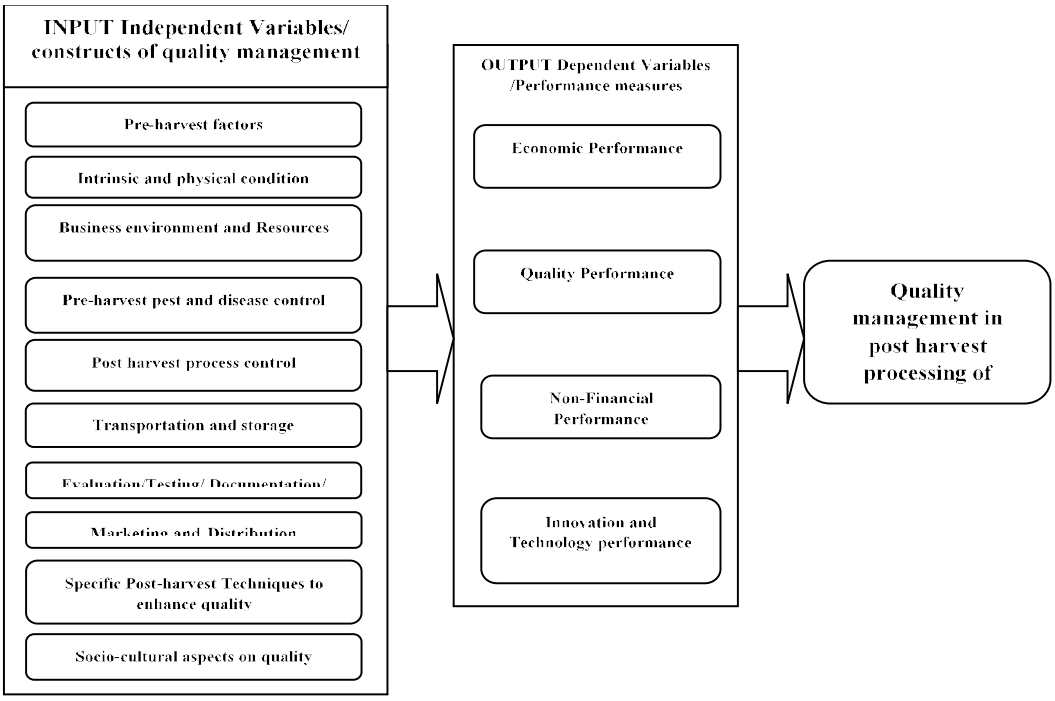


Fig 1: Inter relationship of quality improvement factors and performance measures in post harvest citrus processing

2005). It is crucial for the organization to achieve a successful implementation of TQM to encourage the employees to participate in all these activities. Eckes, (2000) identified certain points which are driving the resistance for change in an organization or industry. According to Sila and Ebrahimpour, (2002), this dimension includes the organization's responsibility for good public citizenship and the protection of the environment and people's health as well as resource conservation.

The understanding of quality management philosophy and its measurement techniques: Several authors have proposed different quality measures that affect quality, financial, business and other performances. Literatures review identified different variables used for measuring organizational performance as shown in Table 2. In this study, organizational performance will be measured in four categories, which is Quality, Economic, Non financial and Innovation and technology performance as suggested by different authors. Fig.1 shows the inter relationship of quality improvement factors and performance measures in post harvest citrus processing.

Quality Management is essentially a way of planning, organizing and understanding of each activity, and depends on each individual at each level. The approach must focus on developing a problem-prevention mentality (Oakland, 1993). The central focus of the total quality management approach is the customers, whose expectations must be satisfied by organization seeking to supply them with goods and services. Identifying, formulating, specifying and communicating a vision for an organization is very essential (Seetharamam, 2006). Figure 1 shows the Inter relationship of quality improvement factors and performance measures in post harvest citrus processing.

Lakhal, *et al.,* (2006) confirmed the relevance of data-based factual decision-making by pointing out that information and analysis have a significant direct effect on various performance measures. Choi and Eboch, (1998) also show in their study that information and analysis and plant performance are correlated positively.

CONCLUSION

From the review, we can conclude that implementation of quality management in post harvest processing of citrus may take longer time to implement, and requires major changes in cultural aspects as well as stake holder mindset in citrus industry. Leadership, management, finance, organizational culture, skills and expertise are considered as the generic factors critical for the successful implementation within SMEs environment and repeatedly recommended in literatures and research findings. In this particular study some new or modified constructs or factors pertinent to citrus industry have only been considered. Judgmental process of grouping similar requirements led to the classification of all these requirements into ten separate categories as dependent variables. Items identified for the purpose of measuring the performance of post harvest processing aspect are clubbed in to four categories. The empirical study shall be conducted using the proposed Post-harvest citrus quality management constructs in order to validate the CSF's in post harvest quality management of citrus fruits.

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