

# Response to Reviewer 1 Comments

Title: A holistic packaging efficiency evaluation method for loss prevention in fresh vegetables cold chain

The objective of the study is to evaluate the efficiency of conventional packaging of fresh produce and propose improvements for cold chain management.

Response 1: Thank you for your review and objective comments.

This paper is a holistic method for evaluating the packaging efficiency of fresh produce in cold chain, and based on it more targeted improvements in real cold chain was proposed, realizing the visualization of packaging efficiency in real cold chain.

Specifically, we evaluate the packaging efficiency from a more comprehensive perspective based multi-sensor devices to monitor environmental data in the package. And this method was tested using a packaging practice in China. Finally, compare the effects of efficiency evaluation before and after the method used, including real-time, visualization, and so on. Please see the revised *Abstract*.

How was the target food category selected? What is the dependence of fresh produce quality and shelf life on packaging type? The study is interesting and of scientific value. However some modifications and improvements are strongly suggested in order to be adequate for publication.

Response 2: Thank you for your comments to this manuscript.

Q1: Please check the *Material and Methods*. (1)fresh vegetable catch relatively less attention in typical cold chain; (2) leafy vegetables are perishable and vulnerable with short shelf life, easy to assess; (3) such as *Spinach* and *Chinese parsley* are seasonal vegetable, which are common and easy to obtain.

Q2: It is reflected in two aspects, which are covered in this manuscript, that the dependence of fresh produce's quality and shelf life on packaging type. (1)Since packaging has the characteristics of a unit that reduces mechanical damage, it constitutes a microenvironment, and can be traced for enhanced traceability, and other benefits mentioned in *Introduction*. (2)Meanwhile, efficient packaging methods such as MAP, intelligent packaging, etc., focus on one aspect of these aspects, such as loss prevention, environmental friendly, mechanical damage, easy for preservation technologies adaption. But the efficient packaging for fresh produce in real cold chain is rare, which also lead the maladjustment for fresh produce, especially for raw material. (3)In addition, the differences in the quality of these different fresh vegetables and the shelf to package dependence are neglected, so it is necessary to clarify the dependence by comprehensive packaging efficiency analysis and giving more targeted suggestions. Therefore, it is precisely because of the interaction and influence of the above micro-environment with fresh produce, and the high packaging costs and shorter shelf-life, it is necessary to continuously improve the dependence and specific packaging and packaging types.

Q3: Since the growing loss and sustainable issues found in real cold chain for fresh produce, we propose such a comprehensive evaluation method in the manuscript, which is more suit to the ongoing improvement for efficient packaging practices. And it was also designed for the aim of

the efficiency visualization, targeted improvement to reduce losses and promoting the management of cold chain practices.

Q4: Unfortunately, due to the insufficient proficiency and bad presentation skills in English in previous version, it arouses confusion and ambiguity. Certainly, your suggestions for adjustments and improvements involved are pertinent, and we have carefully considered and revised them.

How was sample temperature monitored during distribution and storage? What is the connection of the monitored parameters with the quality and shelf life of the packed fresh produce?

Response 3: In the same way, the multi-sensor device based on IoT with communicated function can also be adapted to the distribution and storage, which can retrieve the data. Specifically, it is shown in *Figure 1*.

The introduction briefly introduces the exposure of fresh agricultural products to temperature and humidity, micro-environment compromise, and stress to unsuitable environmental conditions. At the same time, because the package is a closed unit space, the performance of monitoring parameters can also reflect the respiratory rate and also have correlation with the decay of quality. Besides, previous studies have had little research on the monitoring of these gases, normally the humidity and temperature, the connection and condition has been neglected. Hence, monitoring the micro-environmental parameters can reflect the interaction between the condition of vegetables and packaging.

Specifically, carbon dioxide and oxygen are the respiratory conditions that reflect fresh vegetables, and ethylene is an auxin that accelerates the degradation of quality.

What is the effect of the alternative packaging types on the packed food in terms of nutritional value, instrumentally measured quality indices and sensory properties?

Response 4: Thanks for your question and advice. The nutritional value, instrumentally measured quality indices and sensory properties for packed fresh produce are important and we had considered them before our research. Since the main point related of current manuscript is the loss prevention performance, which is calibrated by the loss rate in the process.

Besides, we have mentioned the lack of these specific qualities and perceptual indicators in *the data acquisition section* of this manuscript. And we also have clarified the necessity of in-depth research of nutritional value, instrumentally measured quality indices and sensory properties of packaged fresh produce in further research in the *Conclusions* part in this manuscript.

In addition, the work of this manuscript is to carry out the packaging efficiency evaluation and its visualization from three layers mentioned in *Figure 2*. The quality and nutritional value is obviously a more subtle level belongs to loss prevention performance. And this paper mainly focuses on information and management, rather than the micro-perspective of change of nutrition.

The study is rather descriptive, statistical analysis should be performed in order to compare and discuss the obtained data.

Response 5: Thank you for your objective comments.

The article is indeed descriptive. As mentioned above, the main highlight of this manuscript is the

contribution to improved indicators proposed in the packaging efficiency evaluating method. It is the description of the evaluation method and the effect of the method before and after, which is descriptive.

Meanwhile, considering the length of this manuscript and the data volume, the statistical analysis will be elaborated and considered in our subsequent work.