Determination of spoilage levels of fresh fruit and vegetables according to the type of packaging

Executive Summary

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Stiftung Initiative Mehrweg (Foundation for Reusable Systems)

Fraunhofer Institut für Materialfluss und Logistik
(Fraunhofer Institute for Material Flow and Logistics)
Abteilung Verpackungs- und Handelslogistik
(Packaging and Trade Logistics Department)
Dipl.-Logist. (Certified Logistian) Michael Pelka
Joseph-von-Fraunhofer-Str. 2–4
D-44227 Dortmund
Tel.: +49 (0) 231 9743 281
Fax: +49 (0) 231 9743 311
Email: michael.pelka@iml.fraunhofer.de
Website: www.iml.fraunhofer.de

Rheinische Friedrich-Wilhelms-Universität Bonn
Institut für Tierwissenschaften (Institute for Animal Science), Arbeitsgruppe Cold-Chain Management
(Cold-Chain Management Working Group)
PD Dr. Judith Kreyenschmidt (Food Technologist)
Katzenburgweg 7–9
D-53115 Bonn
Tel.: +49 (0) 228 73 38 86
Fax: +49 (0) 228 73 26 17
Email: j.kreyenschmidt@uni-bonn.de
Website: www.ccm.uni-bonn.de

The debate on the handling of fresh foodstuffs in Germany has gained new momentum, not least through the film *Taste the Waste*. Although statistics on how much food is thrown away unused in Germany vary greatly, there is, however, a consensus that the amount needs to be reduced. Estimates of food wastage range from around 20 million tonnes per year – for total domestic wastage in Germany (source: *Taste the Waste*) – to as much as 300,000 tonnes for the German food trade as a whole (source: EHI). This significant variation between different sources clearly shows that there is still not enough transparency with regard to wastage. This also applies to fresh fruit and vegetables. In this connection, it is of particular interest whether and to what extent the packaging method used (disposable vs reusable packaging) influences the spoilage of products. The Fraunhofer Institute for Material Flow and Logistics and the Cold-Chain Management Working Group at the University of Bonn have addressed this problem. Their study investigated the potential link between packaging damage and packaging type on the one hand, and the potential link between loss of freshness of fruit and vegetables and packaging type on the other.

Empirical determination of damage to disposable and reusable packaging

Packaging damage was first of all assessed following transport from the producer to the central warehouse (first distribution level) and then following transport from the central warehouse to retail outlets (second distribution level).

After the first distribution level, a damage rate of 0.02% was observed for reusable packaging and 0.82% for disposable packaging. Of the different types of disposable packaging (corrugated cardboard, solid cardboard, wood), packaging made from solid cardboard had an above-average damage rate, at 2.46%, whereas packaging made of wood showed a significantly below-average damage rate, at 0.08%. The damage rate for disposable packaging made of cardboard or cardboard boxes (disposable wooden packaging was not considered) amounts to 0.88%. In the case of reusable packaging, causes of damage are mainly due to poorly secured loading units and improper handling; in the case of disposable packaging, causes of damage were largely due to insufficient packaging stability.

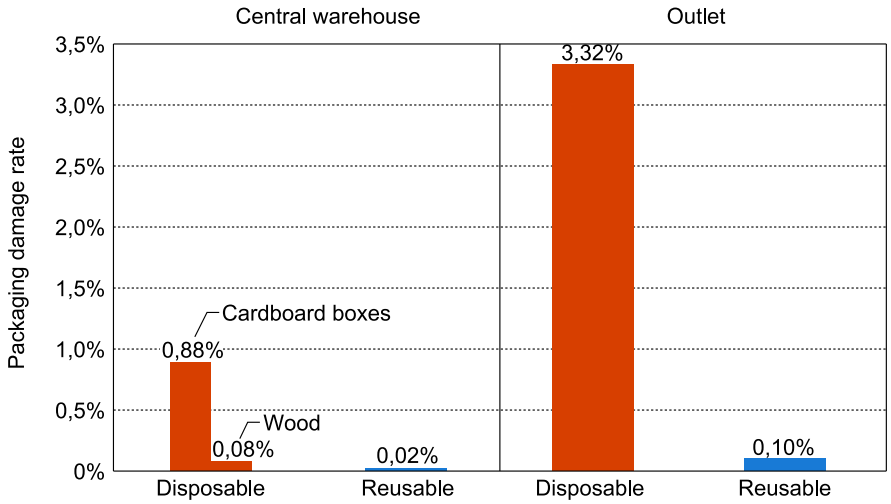

Figure 1: Comparison of packaging damage rates

At the second distribution level, a significantly higher damage rate was observed compared to the first level, in principle due to inhomogeneous loading units – made of different types of packaging – being put together for individual outlets. Reusable packaging had a damage rate of 0.10%, while the rate for disposable packaging was 3.32%. The causes of damage for reusable packaging were exclusively limited to improper handling. Three quarters of all damage caused to disposable packaging was due to a lack of standardization, specifically a lack of consistency in modular packaging dimensions and a lack of compatibility between different types of packaging.

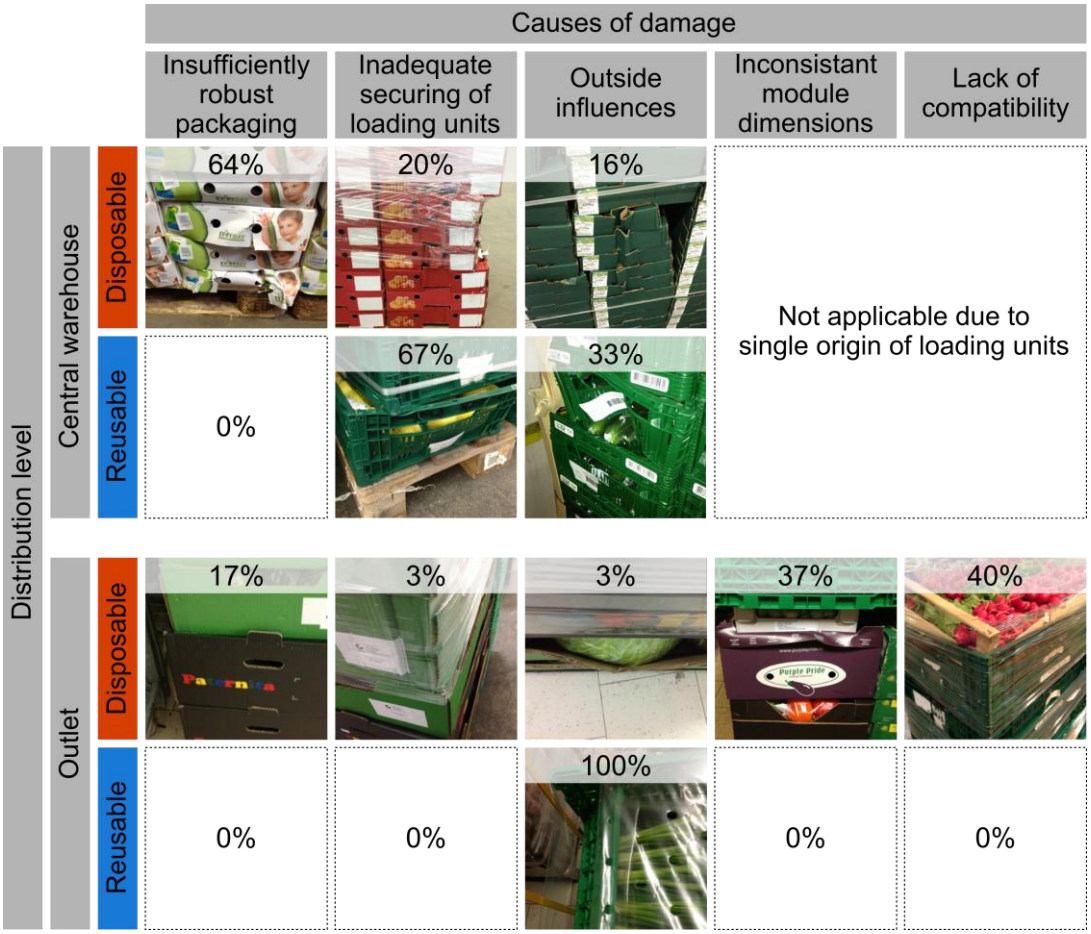

Figure 2: Comparison of causes of damage

Throughout the whole supply chain, from the producer to the outlet, around 4% of all disposable packaging was damaged. For reusable packaging, the figure was just 0.1%.

In addition to packaging being damaged, the quality of the goods transported may also be compromised. In the central warehouse, around 40% of fruit and vegetables that arrived in damaged disposable packaging were also partly damaged; for reusable packaging, however, the figure was around 22%. In the retail outlets, around 20% of produce that arrived in damaged disposable packaging was also partially damaged; however, no damage was observed for produce transported in reusable packaging. It should be noted that the study did not take into consideration the final destination of damaged produce, or indeed undamaged produce transported in damaged packaging.

The overall conclusion of this investigation was that the nature of the packaging (disposable or reusable) has a significant influence on the packaging damage rate. Compared to disposable packaging, reusable packaging suffers significantly lower rates of damage. When extrapolated to the current market situation, it was estimated that around 36,000 tonnes of fruit and vegetables, with a market value of some €68 million, are damaged when disposable packaging is used exclusively. When reusable crates are used exclusively, the estimated wastage is 1,100 tonnes, with a market value of around €2 million.

Determining the influence of the type of packaging on the loss of freshness of fruit and vegetables

This study also sought to evaluate the impact of disposable and reusable packaging on the loss of freshness of fruit and vegetables using selected parameters. The study was divided into three parts: in the first part, the comparison of the surface bacterial counts on disposable and reusable packaging was the primary concern. Increased bacterial counts on surfaces (measured as bioburden) indicate a lack of hygiene and subsequently an increased risk of cross-contamination (surface – product). Depending on the type of bacterial flora, it is possible that cross-contaminations may accelerate the loss of freshness and influence the safety of a product.

In the second part, the loss of freshness of selected products, stored in disposable and reusable packaging under laboratory conditions, was compared using sensory and microbiological parameters. Examinations were carried out on radishes, tomatoes and nectarines. In the last part of the study, the loss of freshness in strawberries and lettuce was measured and compared in disposable and reusable packaging under realistic conditions, i.e. beginning with the regional producer.

In this study, with one exception, no significant differences between the surface bacterial counts (measured in terms of bioburden) for disposable and reusable packaging could be found, both before the filling process and at the end of the storage period. During the microbiological examinations, the total bacterial count for the products was measured throughout the process chain. No significant differences were measured between products in disposable packaging and those in reusable packaging.

Furthermore, the results of the sensory evaluations for disposable and reusable packaging were either comparable or did not show any significant differences.

For certain products, such as nectarines and radishes, the position of the packaging (top, middle or bottom) had an influence on the loss of freshness. These differences are mainly caused by temperature-related effects, air-flow velocity and associated changes in humidity. Since the temperature loggers were positioned in the middle of the base of the packaging in this test, these effects were not clearly visible in the measured temperature profile.

No systematic differences were identified inside the disposable and reusable packaging with regard to temperature sequences and humidity conditions.

The results of these regional practice-oriented studies cannot be extrapolated for long-distance transport without a separate investigation. At present, no conclusion can be made on this matter.