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ANALYSIS OF PROVIDED SERVICE QUALITY IN FLOWERS AND LIVING PLANTS TRANSPORT

Adela POLIAKOVÁ

Ing. Adela Poliaková, PhD., Slovak University of Technology Bratislava, Faculty of Materials Science and Technology in Trnava, Institute of Safety, Environment and Quality, Paulínska 16, 917 24 Trnava, Slovak Republic, e-mail: adela.poliakova@stuba.sk

Abstract

This paper analyses quality of the living flowers and plants transportation. A part of this paper compares the demands for a particular transport mode and a practical demonstration of these transport modes within a specific transport mode. The paper presents a survey of quality of services provided by individual transport modes.

Key words

flowers, living plants, flowers and living plants transport, CITES, phytoinspection

INTRODUCTION

In the recent years, more than ever, there has been a strong pressure on manufacturers and sellers to constantly improve the quality of products and services. Economic crisis in the business environment has caused that prove of the production quality rather than a matter of prestige is becoming a matter of survival in the market.

In spite of the fact that the Slovak Republic is typical for free growing vegetal and flowery varieties, the foreign trade with this commodity is not very large. In the statistics of foreign trade, which is led by the Statistic Office of the Slovak Republic, the price development in foreign trade with flowers and living plants is a part of the Chapter 06 of Harmonised System. In the price indexes in foreign trade, Chapter No. 06 is named: Live trees and other plants; bulbs, roots and the like; cut flowers and ornamental foliage.

Even though that the Statistic Office of the Slovak Republic follows a movement of this commodity, Chapter No. 06 is absent in the resulting reviews, because the export of flowers and plants from the Slovak Republic is very small in numbers. Import to the Slovak Republic is mainly from the Netherlands with its well-known flower stock exchange in Elsmere where, immediately after the auction, the fresh flowers are moved into the refrigerating road trains.

Quality assessment of transport of this specific commodity is so complicated that consumer satisfaction survey is meaningless in this case and its implementation would produce biased results. Live commodities such as flowers and plants are highly sensitive to quality of service and logistics activities.

Transportation of flowers has specific demands to comply with specific conditions. It depends on local requirement in each country. Live flowers and plants in containers are mainly grown in Europe and transported in air-conditioned containers. The temperature is usually similar to the interiors. Cut flowers, for example orchids, roses, carnations and others are imported by air from tropical and subtropical regions of the world. They are ransported and stored at the temperatures of about 5 °C. Air humidity should be 80% or more.

MATERIALS AND METHODOLOGY OF EXPERIMENT

There are many foreign studies that are aimed at the quality aspect of transport of flowers and living plants.

The much problem discussed is the length of time necessary for the transport chain from the producer to a customer. For example a study named "Transportation costs of fresh flowers: a comparison across major exporting countries" by the Centre for Transportation Policy, Operations, and Logistics in George Mason University studied the supply chain of transportation of flowers from Ecuador – one of the biggest flower producers in the world.

POTENTIAL AFFECTS OF QUALITY THROUGHOUT THE SUPPLY CHAIN (2) Table 1

Process	Time	Potential to affect quality
Post-harvest on farm, Ecuador	4 - 8 hours	Medium
Storage on farm	12 - 72 hours	Low - Medium
Transportation to cargo agencies	1 - 6 hours	Medium
Storage at cargo agency	4 hours	Low
Palletizing, Quito	6 hours	Medium - High
Customs clearance, Quito	0.5 hours	Low
Loading to aircraft, Quito	1 - 2 hours	Medium - High
Flight UIO-MIA nonstop	4 hours	High
Customs clearance, Miami	4 - 12 hours	Low
Depalletizing, Miami	2 - 4 hours	High
Storage at cargo agency, Miami	4 - 72 hours	Low - Medium
Transportation to U.S. retailer	2 hours - 5 days	Medium

Table 1 provides a summary of the amount of time that a shipment of flowers spends under the control of different supply chain members. In terms of the variation in the time used for each process, it is apparent that producers' demand for reliability and adequate interface with other modes has clearly not been met. From the moment of harvest until the time the product arrives to the U.S. retailer, the trip can take anywhere from 44 ½ hours to almost 13 days. Assuming that roses can last up to 14 days in good condition if handled properly after harvesting and a modest retail shelf life expectancy of seven days, it is reasonable to state that

from the seventh day in transit onwards, the cost of time increases as each additional travel day lowers the quality and consequently the price of the product (2).

The time lengthening of plant or flower delivery from grower to the customer is not the only problem that is related to this specific transport. The quality of this good is beyond dispute influenced by suitable transport vehicle solution or the necessary transport conditions observance, e. g. suitable packaging, palletizing, constant temperature keeping, flowers of plants nutrition etc.

There is no unified regulation that would regulate the transport of this commodity in compliance with recognized principles of the nature or living environment protection in the Slovak Republic. The area of the flowers transport is related only to the Ordinance of Ministry of Agriculture of the Slovak Republic of 27th January 1999 No. 2785/1998-100 about phytosanitarian conditions in the import, export and transfer of plants, plant products as well as the things what might be the harmful organism carriers.

Presented Ordinance is listing the living plants and flowers that are liable to the phytocontrol, according to the Annex No. 2. The system of inspection is presented in Table 2. It describes the hygienic conditions of inspection of some flowers as follows: rose, chrysanthemum, clove, gerbera and other flowers must not content the living vermin and must not be affected by illnesses that could endanger their quality; they must not be frozen, slack, putrescent and broken.

SYSTEM OF PHYTOCONTROLS IN SLOVAK REPUBLIC Table 2

If the transported amount is:	*Amount of checked flowers/plants*
to 500 pieces	at least 20 pieces
more than 500 pieces but less than 1 000 pieces	at least 10 pieces
more than 1 000 pieces	at least 15 pieces
When the earth is in shipment, there will be vinegar worm check performed.	

In Slovakia, there is no binding legislation regulating the transport of commodity requiring a highly special treatment. In practice, the companies carry out a lot of special different procedures, especially in packaging and storage, which were mostly taken from the countries of origin of flowers and plants.

We can claim that in the Slovak Republic there are no defined demands for transport vehicle or climate kept inside.

Transportation of flowers is highly sensitive to the speed and timeliness of delivery. Flowers and live plants are live goods that are subject to rapid change if not properly handled. The pressed pulp in the leaves or flowers causes the release of ethylene which accelerates decomposition, which affects other flowers. Transport logistics chain of flowers and plants is therefore demanding for accurate planning of response operations.

In our research, we tried to define ideal conditions for the flowers and plants transportation.

ACHIEVED RESULTS

Flowers and plants are available in numerous different shapes, volumes and stages of maturity. In order to enable transparent trade in flowers and plants in spite of this great diversity, the products are grouped into uniform batches with the same characteristics. Each characteristic has its own grade code. The unambiguous grade codes enable growers, the auctions and purchasing traders to tell at a glance which product is being traded.

As mentioned earlier in this article, for the assessment of transport of such specific commodity as live flowers and plants, it is not appropriate to use consumer satisfaction survey. Therefore, it is appropriate to first consider the possibilities of individual transport means. As the transport of flowers and plants is very sensitive to temperature requirements, packing materials or manipulation of goods, comparison of the requirements for the transport of flowers by different means of transport is not a simple matter.

We therefore theoretically considered the requirements for the transport of flowers and plants by all means of transport. To assess the suitability of a specific transport means, we used the following Table 3. If this type of service satisfies the criterion, it will score a point.

DEMANDS FOR LIVING PLANTS AND FLOWERS TRANSPORTATION VIA DIFFERENT TRANSPORT MODES Table 3

Demand	**Road transport**	**Rail transport**	**Air transport**	**Water transport**
Compliance with CITES	●	●	●	●
Mounting plate Perishable			●	
Compliance with Act No. 193/2005 Coll. of Laws - Plant Health Care	●	●	●	●
Using Envirotainer	●	●	●	●
Phytosanitary Inspection	●	●	●	●
Specified protection and packaging means	●		●	
Transport of live flowers and plants over long distances			●	
Associated goods*				
Delivery of flowers and plants "in house"	●			
The use of special vehicles - Temperature monitoring	●	●		
A well-supplied	●		●	
Verification of lists of protected plants*				

* presently, it is not applied in any transport mode in the Slovak Republic

We can use the following formula for calculating the suitability of individual transport means.

$$S_{TM} = \frac{\sum_{i=1}^{n} P_{+}}{\sum_{i=1}^{n} P_{p}}.100 \quad [\%], \tag{1}$$

where:
S_{TM}… suitability of transport means,
P_{+}… number of positive points,
P_{p}… total number of possible positive points.

Calculated results are listed in Table 4.

RESULTS OF CALCULATING SUITABILITY Table 4

Transport mode	Road transport	Rail transport	Air transport	Water transport
Suitability	66.66 %	41.67 %	66.66 %	33.33 %

The above calculations show that the road and air transport or their combination is the best for the transportation of sensitive goods. The least suitable is water transport, where flowers and plants could suffer significant harm.

The main factors for storage and transportation of fresh flowers and plants:

1. Temperature
2. Ventilation
3. Humidity
4. Ethylene (ethene).

1. Temperature

- The most important factor in the management of growth and development;
- The need for temperature control;
- Optimum temperature of -2 to 34 °C as the type of plant, the use, the period and the like;
- When storing live flowers and plants for a short time at a temperature above or belowthe desired temperature can cause physiological injury to flowers and plants.

2. Ventilation

- It is essential to provide proper air flow and exchange throughout the storage or transportation;
- Adjust the temperature; where higher temperatures, more intense ventilation must be provided.

3. Humidity

- Control of relative humidity during storage or transport may lead to a reduction of root development and the development of disease - assault flowers and plants;
- To prevent the development and destruction of these diseases (parasitic fungi and molds), use chemicals - fungicides. It should be noted that they must be registered. Requirements vary with each country and are always subject to change. Users should consult with relevant government agencies to determine which pesticides are approved.

4. Ethylene (ethene)

- Gaseous plant hormone;
- Not every plant contains the same hormone. If ethylene is combined with another, or there is an excess of ethylene, it might cause poor quality of vegetable product;
- Ethylene accelerates the death of the flowers. The most sensitive to ethylene are carnations, roses, orchids, lilies and gypsofila.

The experiment was conducted as follows. We chose four cut flowers: rose, carnation, iris, gerbera and a potted flower - violet. We cleaned a refrigerator with a measurable

temperature and adjusted the temperature to 7 °C. Flowers were plased to the refrigerator "dry" in the horizontal position.

Flowers were checked several times a day for the aging process or destruction. Results of the checks were recorded on the scoreboard with the written point values chosen at the beginning of the experiment. Plants were monitored for 10 days; if any of them showed the lowest rating, it was removed from the refrigerator.

After the first phase of the experiment, we placed a fresh new sample in the refrigerator; temperature was set to 4 °C and the process was repeated. The same experiment was carried out once more at 12 °C.

DISCUSSION

The transport vehicle selection is also an important problem of the living flowers and plants transportation. There are foreign transporters that specialize in transportation of such commodities. The temperature control during transport is necessary.

OPTIMUM STORAGE TEMPERATURES FOR SELECTED CUT FLOWERS Table 5

Flower species	***Storage temperature °C***	***Maximum period of storage***	***wet/dry***
Astra	0-4	1-3 weeks	-
Chrysanthemum	1	3 weeks	-
Cyclamen	0-1	3 weeks	-
Orchid	5-8	4 weeks	-
Dahlia	4	3-5 days	-
Delphinium	4	1-2 days	-
Gerbera	4	3-4 weeks	wet
Gladiolus	2-5	1-4 weeks	dry
Freesia	0-0.5	10-14 days	-
Narcissus	0-0.5	1-3 weeks	-
Lily	0-1	4-6 weeks	dry
Rose	0.5-3	2 weeks	dry
Strelitzia reginae	8	4 weeks	-
Tulip	-0.5-0	2-3 weeks	dry
Zinnia	4	5-7 days	-

Presently, more foreign studies are aimed at the problem of keeping constant temperature during the storage and transportation of flowers. Unfortunately, the Slovak Republic is kept behind also in this area. The result of the study named: "Quality flowers are cooled flowers" by New Zealand King Research Institute was the experimental definition of the optimum storage time and an ideal storage temperature. Table 5 lists examples of some selected plants storage.

The desired temperature in the cargo space of the vehicle prior to and during transportation of vegetable goods within our research is listed in Table 6.

OPTIMUM STORAGE TEMPERATURES FOR SELECTED CUT FLOWERS

Table 6

Sort of flower	***Distribution duration and temperature at ºC***
Rose	24 hours at 4 °C
Gerbera	24 hours at 7 °C
Carnation	24 hours at 4 °C
Iris	24 hours at 7 °C
Violet	24 hours at 12 °C

Flowers that are more pulpy, watery and softer (e.g. iris), are also sensitive to an elevated temperature; they quickly dry up, and therefore have a short lifetime. Significant lowering of the temperature is not the solution, because at about 0 °C signs of freezing appear. For such group of flowers, transport "in the water" at about 4 °C is therefore the most appropriate.

The flowers, which do not contain such a large amount of water and are naturally drier and even stronger (e.g. rose) better tolerate lower temperatures; at higher temperatures they also age faster and ripen. Drying up does not occur as fast as in the "softer" plants, so it is economically suitable to transport them "dry" at about 1 °C.

Potted plants are sensitive to lower temperatures. After prolonged exposure to lower temperatures before being transferred to the "room" temperature, the total destruction of the flower follows. For such flower, the most appropriate means of transport is therefore the one with the temperatures around 18 °C and with dewing irrigation.

CONCLUSION

A steady development of floriculture industry, specialisation of growers in the production of particular species as well as a great concentration of cultivation areas have led to the development of free markets for flowers in large cities and urbanized centres.

All of these changes have led to a temporary overproduction of flowers and great losses of the produced commodities. In order to limit these losses, growers and scientists initiated the research toward the elaboration of suitable methods for the preservation of flowers after harvest and for their long distance transportation to market centres. They soon found low temperature treatment to be the most important factor enabling the preservation of freshly cut flowers for days and even weeks without a great loss of their quality. In the next step, the cold has been used in refrigerated trucks and containers for long distance transportation of floriculture plants (6).

Flowers and plants are a live, evolving material, which requires not only strict adherence to constant temperature, recommended conditions, but also require extra care when handled.

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Reviewers:

doc. Ing. Vladimír Konečný, PhD.
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