ПРОБЛЕМИ БЕЗПЕЧНОСТІ ТОВАРІВ

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PRESENT-DAY SOLUTIONS WITH REGARD TO PACKAGING OF FOOD PRODUCT

Introduction. The directions of development of the global packaging market depend on the degree in which the needs of that market are met by individual segments of the packaging industry. Those needs are formed by the growing role of the consumer in the determination of the quality of packaging, requirements of the protection of the natural environment and the development of new systems of sale and promotion of goods. The quality changes in packaging will mostly consist of [1]:

- growing differentiation of the packaging resulting from a larger number of distribution channels (e.g. e-shopping) and fragmentation of target markets,
- increasing role of the protection function of the packaging in connection with the protection of the human health and with the enhancement of the quality of the packaged goods,
- size co-ordination in the combination packaging-transport-storage, ensuring the maximum efficiency of utilisation of the loading and storage space, a particularly important requirement in the context of increasing share of mixed cargo,
- mechanisation and automation of loading operations,
- enhancement of the research of the threats occurring in individual phases of the distribution of goods in packaging, in order to preserve the quality of such goods, for instance by eliminating extreme loads in the category of mechanical risks.

[1] *Lisińska-Kuśnierz M*. Modern Packaging / M. Lisińska-Kuśnierz, M. Ucherek // Polish Food Technologists Society. — Cracow, 2003; *Lisińska-Kuśnierz M.* Technical Progress on Field of Packaging / M. Lisińska-Kuśnierz, M. Ucherek // Focusing New Century: Commodity-Trade-Environment: Proceedings of the 14th IGWT Symposium, China, August, 25—29. — Beijing, 2004. — Vol. I. — P. 256—259; *Lisińska-Kuśnierz M*. Technological Advancement in the Packaging Industry / M. Lisińska-Kuśnierz, M. Ucherek // Publishers of Cracow University of Economics. — Cracow, 2003.

The main lines of development in the contemporary packaging industry are calculated so as to obtain an optimum kind of packaging for a specific product. The ever widening spectrum of the available packaging materials, possibility to modify them at will, and the possibility to go so far as to program their desired properties, combined with the growing requirements of the consumers, the competition which gets stronger every day, and the aspect of the protection of the natural environment ensure a permanent development of the packaging, first of all in respect of food products [2].

The aim of this work was to present some examples of modern solutions regarding to packaging of food product like as active and intelligent packaging, bag in box packaging as well as biodegradable packaging.

Active and intelligent packaging. Active packaging is food packaging, which has an extra function in addition to that of providing a protective barrier against external influence. It can control, and even react to, phenomena taking place inside the package. Intelligent packaging monitors to give information on the quality of the packed food. The different types of active packaging are categorized into two groups, with regard to their way of functioning, as following: scavengers and absorbers [3].

Active packaging – scavengers consists of ingredients, which are intended to absorb, remove and then eliminate substances, such as oxygen, ethylene, moisture, or taint from the interior of a food package. The constituents in this type of active packaging material and articles are not intended to have any direct effect through migration on the food itself, but will, however, in most cases, have an effect on the shelf life or the organoleptic properties of the food.

Absorbers can be applied to the food package either by incorporating them in the packaging, sometimes as layers in the material, or as separate food contact articles, like sachets or other types of articles. Some examples of active packaging – absorbers are presented in *table 1*.

Active packaging-emitters contains, or produces, substances, which are meant to migrate into the food packaging headspace or into the food in order to obtain a technological effect in the atmosphere in the packaging or in the food itself as e.g., either food additives, flavourings or biocides. In these cases, the consumer together with the food ingests the components. Some groups of emitters are described in *table 2* .

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[2] *Lisińska-Kuśnierz M*. Modern Packaging … Cracow, 2003; *Packaging* of Food / Ed. by B. Czerniawski and J. Michniewicz. — Czeladź : Agra Food Technology, 1998.

[3] *A Nordic* Report on the Legislative Aspects. Active and Intelligent Packaging, B. Fabech et. al, Copenhagen, 2000; *Robertson L. G*. Food Packaging: Principles and Practice. — New York : Marcel Dekker Inc., 2000 ; *The Wiley* Encyclopedia of Packaging Technology / Ed. by A. Brody, K. Marsh. — New York ; Toronto : J. Wiley and Sons, 1997.

Table 1

Examples of active packaging-absorbers [4]

Type	Examples of components used	Examples of use areas
Oxygen absorber	Ferro-compounds, ascorbic acid, metal salts, glucose oxidases	Cheese, bakery wares, confectionery, nuts, milk powder, coffee, tea, beans, grains, pasta, meat products, ready-to-eat products
Humidity absorbers	Glycerol, clay, silicium oxide, propylene glycol, poly acrylates	Bakery wares, meat, fish and poultry, ready-to-eat dishes, cuts of fruits and vegetables
Carbon dioxide absorbers	Calcium hydroxide and sodium hydroxide or potassium hydroxide	Roasted coffee
Ethene absorbers	Aluminium oxide and potassium permanganate, carbon, zeolite	Fruits like apples, apricots, banana, mango, cucumber, tomatoes, avocados, vegetables like carrots, potatoes and brussels sprouts
Absorbers of flavours; amines and aldehydes	Citric acid in polymers; cellulose esters; polyamide	Food which can easily be oxi-dised, like proteins; fats in fish products, snacks and fruit juices

Table 2

Examples of active packaging-emitters [5]

Type	Effect	Examples of use areas
Humidity regulators	Regulation of humidity content	Vegetables
Carbon dioxide emitters	Growth inhibition of gram negative microorganisms	Meat, fish, poultry, ready-to-eat dishes
	Shelf life extension	Unprocessed vegetables and fruits
Ethanol emitters	Growth inhibition of micro-organisms, including pathogens	Bakery wares, dried fish products
Organic acid emitters, e.g. sorbic acid	Antimicrobial	Miscellaneous
Hinokitol emitter	Antimicrobial	Miscellaneous
Sulphur dioxide emitters	Bleaching agent	Dried, white vegetables
	Antioxidant	Various heat treated foodstuffs
	Antimicrobial	Various unprocessed and processed foods
Pesticide emitters, e.g. imazalil, pyrethrins	Antimicrobial, fungicidal or pest control	Dried, sacked foodstuffs e.g. flour, rice, grains
Preservatives e.g. allylisothiocyanate	Antimicrobial	Meat, unprocessed fruits
Antioxidants, e.g. BHA, BHT, tocopherol	Antioxidation	Dried foodstuffs, fat containing foodstuffs
Flavouring emitters	Prevention of off-flavour	Miscellaneous

[4] *A Nordic* Report on the Legislative Aspects … Copenhagen, 2000.
[5] Ibid.

Intelligent packaging – indicators have been presented to the producers of packed foodstuffs – indicators for temperature, microbial spoilage, package integrity, physical shock, and product authenticity. Indicators in or on the food package can give information on the quality of the food product directly, on the package and its headspace gases, as well as on the storage conditions of the package. Some indicators do not need to interact with the product or the headspace, while others do [6].

These indicators are often called intelligent packaging and certain concepts are already commercially available, and their uses seem to be increasing. New concepts of leak indicators and freshness indicators are patented, and it can be expected that new commercially available products will be assessable in the near future. Some groups of intelligent packaging are described in *table 3*.

Table 3

Examples of intelligent packaging [7]

Type	Effect	Examples of use areas
Time-temperature indicator	Information on temperature/-history and variation in temperature	As supplement to labelling in storage or transportation
Oxygen indicator	Information on leakage	Modified or controlled atmosphere food packaging
Carbon dioxide indicator	Information on concentration of carbon dioxide in modified atmosphere packaging	Modified or controlled atmosphere food packaging
Colour indicator	Information on temperature in a food packaging	Food for microwave preparation
Pathogen indicator	Information on microbiological status	Meat, fish or poultry
Breakage indicator	Information on broken packaging	Canned baby food

"Bag in box" packaging. For more than ten years, the "bag in box" packaging have been used worldwide for packaging various food products in liquid form, including wines, fruit juices and beverages, milk drinks, and first of all primarily for mineral water. "Bag in box" is a packaging composed of a carton box with a foil bag placed within, made of a homogeneous foil or laminate with a valve which ensures a gradual dosage of the product, preventing any contact with air. Constructional solution of "bag in box" packaging is presented on *fig. 1* [8].

[6] *A Nordic* Report on the Legislative Aspects … Copenhagen, 2000; *Robertson L. G.* … New York : Marcel Dekker Inc., 2000; *The Wiley* Encyclopedia of Packaging Technology … 1997.

[7] *A Nordic* Report on the Legislative Aspects … Copenhagen, 2000.

[8] *Lisińska-Kuśnierz M.* Modern Packaging … Cracow, 2003; *Ucherek M.* Implementation of Modern Packaging Systems as Determinant of Marketing Srategies Realization / M. Ucherek // Товари і ринки. — 2006. — № 2. — С. 31—38; *The Wiley* Encyclopedia of Packaging Technology … 1997.

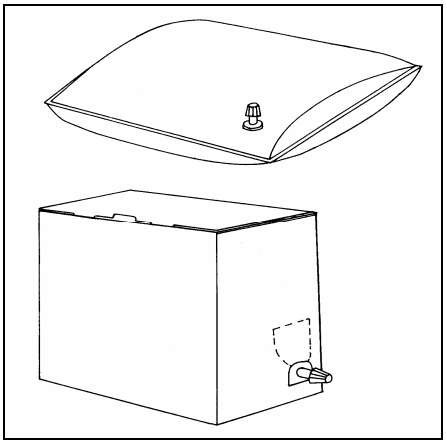

Fig. 1. Constructional solution of "bag in box" packaging [9]

Such packaging may be used for both non-aseptic and aseptic packaging, depending on the properties of the product and the requirements with respect to a specific period of durability. The packaging of that kind combine a perfect protection of the product quality and the care for the condition of the natural environment.

The principle of the "bag in box" system is the application of small/large bags with a valve used to fill the packaging and pour out the liquid without letting the air in. Thanks to such solution, the burden on the natural environment is reduced, mainly owing to smaller quantity of materials used to produce one packaging unit compared to other kinds, for instance metal packaging, to the high recyclability of materials, resulting from their easy separation, reduced quantity of packaging as a result of better adapted volume, and where possible, using large size containers.

Another advantage of such packaging is the low cost of disposal of the generated waste. Because it can be disassembled, the recycling of such packaging is also much cheaper. That is due to the weight proportion: 80 % – cardboard and only 20 % – man-made material. Furthermore, the cost of transport of the products packaged using the "bag in box" system is much lower than in case of other kinds of packaging. A long durability of products is obtained by aseptic packaging [10].

A high cleanness of the inside coating and the absolute protection against light make this packaging very useful for a large spectrum alimentary products and liquids including: wines, juices, vinegar, alimentary oil, mustard, alimentary dyes, fragrances, essences, mineral and table water, syrups, honey, fresh milk, etc. Packaging of that kind is not well known in market, in spite of its numerous advantages.

[9] *Packaging* of Food … Czeladź : Agra Food Technology, 1998.

[10] *Lisińska-Kuśnierz M.* Modern Packaging … Cracow, 2003; *Packaging* of Food … Czeladź : Agra Food Technology, 1998; *Ucherek M.* Innovative Approach to the Systems of Food Products Packaging / M. Ucherek // Analele Universitatii Din Oradea Romania, Facultatea de Stiinte Economice. — Oradea, 2005. — Vol. XIV. — P. 160—164.

The "bag in box" packaging constitutes an interesting proposal for the consumer, as its structure is well-adapted to be a medium for easily absorbable information, and ensures a great comfort of use. Yet, such packaging is still too little known and popular on the market, because of the price perceived as too high. However, the interest in that packaging will grow because of its environmental aspect, to wit, easy recyclability of each of the components of the "bag in box" packaging [11].

Biodegradable packaging material. The biodegradable packaging is environment friendly, allowing to solve the problem of a growing quantity of packaging waste and enabling the companies to comply with their obligations with regard to the environment protection aspect of the packaging solutions they use. The Directive of 20 December 1994 on Packaging and Packaging Waste defines requirements for packaging to be considered recoverable [12]. EN 13432:2000 amplifies these requirements with respect to organic recovery. Organic recovery of used packaging is one of several recovery options within the overall life cycle of packaging [13].

Organic recovery of packaging and packaging materials, which includes aerobic composting and anaerobic biogasification of packaging in municipal or industrial biological waste treatment facilities is an option for reducing and recycling packaging waste.

EN 13432:2000 specifies requirements and procedures to determine the compostability and anaerobic treatability of packaging and packaging materials by addressing four characteristics: biodegradability, disintegration during biological treatment, effect on the biological treatment process and effect on the quality of the resulting compost [14].

In case of packaging formed by different components, some of which are compostable and some other not, the packaging itself, as a whole is not compostable. However, if the components can be easily separated by hand before disposal, the compostable components can be effectively considered and treated as such, once separated from the non compostable components [15].

Compostable packaging materials are derived from nature and return to nature after being used. They are therefore referred to as ‘renewable’ raw materials. A closed natural cycle is involved in the use of such materials, thereby minimizing the use of fossil fuels as well as CO2 emissions (*fig. 2*).

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[11] *Lisińska-Kuśnierz M*. Modern Packaging … Cracow, 2003; *Packaging* of Food … Czeladź : Agra Food Technology, 1998; *Ucherek M.* Innovative Approach to the Systems of Food Products Packaging … P. 160—164.

[12] Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste (OJ L 365, 31.12.94. — P. 10).

[13] EN 13432 (2000). Packaging. Requirements for Packaging Recoverable through composting and biodegradation.

[14] Ibid.

[15] *Roots* Environmentally Friendly Packaging Materials (www.moonenpackaging.com 10.2008); *Ucherek M*. Packaging and Protection of the Natural Environment / M. Ucherek : Publishers of Cracow University of Economics. — Cracow, 2005.

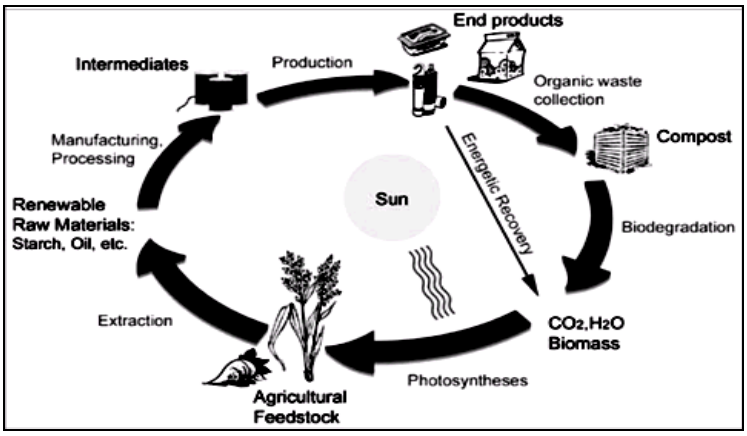

Fig. 2. A closed natural cycle of compostable packaging material [16]

Whether or not packaging is compostable is set out in a European standard (EN 13432) [17]. In other words, such packaging must comply with a series of requirements. Various tests are therefore carried out, not only with regard to biodegradation, disintegration and compost quality and the absence of heavy metals. To meet these requirements, packaging materials processed in an industrial composting facility must be degraded by up to 90 % within 12 weeks. If this is confirmed by an independent laboratory, then the producer may apply for a certificate from a certification institute. Packaging materials which are comply with the EN 13432 standard may display the logos (Belgium, Germany, the Netherlands, UK, Switzerland, Poland) which are presented on *fig. 3* [18].

Fig. 3. Logos of compostable packaging material [19]

[16] *Roots* Environmentally Friendly Packaging Materials. — Way of access : http://www.moonenpackaging.com 10.2008.

[17] EN 13432 (2000). Packaging. Requirements for Packaging Recoverable through composting and biodegradation.

[18] *Roots* Environmentally … http://www.moonenpackaging.com 10.2008; *Żakowska H.* Packaging Waste / H. Żakowska : Polish Packaging Research and Development Centre (COBRO). — Warsaw, 2003; *Żakowska H.* Biodegradable Packaging / H. Żakowska : Polish Packaging Research and Development Centre (COBRO). — Warsaw, 2003.

[19] *Roots Environmentally* ... http://www.moonenpackaging.com 10.2008.

On the market can be used for example the following compostable packaging: cutlery, drinking cups, vegetable and fruit trays, packaging foil including flow-pack foil, bags (potato bags, carrot bags etc.), label, salad trays and carrier bags. Compostable packaging material has a lot of positive effects: company chooses to do business in a socially responsible fashion, customers end up with less waste material and company generate 'environmental added value' for products and company [20].

Conclusion. Recapitulating, we can say that the manufacturers have to pay attention to the improvement of the properties of packaging materials and packaging, traders and marketing specialists – to their importance for the promotion of the offered goods and their role in the marketing tactics of the companies, and the environmentalists – to the lessening of the burden on the environment caused by used packaging. The economic factors related to the production of packaging and implementing specific packaging systems are also important.

The combination of the ambition to improve the quality of products, packaging materials and packaging used, with a rational minimisation of their cost, an increasing role packaging has to play in the marketing strategies of products, and the protection of the natural environment, constitutes an extraordinarily difficult challenge which the packaging sector will have to face in the forthcoming years.