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THE FUTURE OF PHARMACEUTICALS' PACKAGING

DOKĄD ZMIERZAJĄ OPAKOWANIA NA FARMACEUTYKI

Summary: Pharmaceutical industry is nowadays the most dynamically developing branch of the industry. Packaging plays the important role in this respect. The present paper contains the results of the survey studies concerning the packaging of pharmaceuticals, including their most significant features, with the consideration of those which satisfy the expectations of the consumers. From the mentioned above questionnaire it is followed that the safety of the packaging is the most important aspect and their environment-friendly feature is the least important factor.

Keywords: packaging of pharmaceuticals, type, properties

Streszczenie: Przemysł farmaceutyczny jest obecnie chyba za najdynamiczniej rozwijającym się. Opakowania odgrywają tu istotną rolę. W pracy zawarto wyniki badań ankietowych dotyczących opakowań na farmaceutyki, obejmujące najbardziej istotne ich cechy, z uwzględnieniem tych, które najbardziej odpowiadają Konsumentom. Wynikło z nich, że najważniejsze jest ich bezpieczeństwo, zaś najmniej istotnym czynnikiem okazała się ich proekologiczność.

Słowa kluczowe: opakowania farmaceutyków, ich rodzaje i właściwości

Introduction

Pharmaceutical industry is recognized as one of the most profitable sectors of the industry. Its leaders include the United States of America, the European Union and Japan. Polish pharmaceutical market occupies the 6th place in respect of the size in Europe what gives ca. 5-% participation in the European market and ca. 1.4% share in the world market. The value of sales of pharmaceuticals in Poland in February 2014 was estimated at the level of 2 256 million PLN. According to Polish law, the direct packaging of medicinal product is the packaging which has a direct contact with the mentioned medicinal product. The external packaging of the pharmaceutical product serves for placing the direct packaging inside [1].

The packaging of pharmaceuticals is, therefore, a special type of packaging. It is subjected to legal regulations. It should also satisfy very restrictive requirements of safety. At the same time, the packaging should play the basic functions, and namely:

- protective
- logistic
- informational,
- utility,
- marketing.

The significant aspect of pharmaceutical packaging production consists in the fact that the packaging material does not have any effect on the product and the product does

not have any influence on the packaging material. More and more frequently, plastics are employed in manufacture of pharmaceutical packaging; they are lighter, easier to be moulded in diverse shapes and, in comparison to other materials, they give greater possibilities. In pharmaceutical industry, the polymer nanocomposites are a novelty. They are able to ensure the appropriate barrier capacity, resistance and other desired properties of the future packaging of pharmaceuticals. Similarly as in other branches of packaging market, there is also more intelligent packaging in pharmaceuticals, the task of which is to make the communication with the user easier in respect of the drug's stability. Moreover, the mentioned packaging may affect positively the quality of the product.

Packaging of medicinal products belongs to the group in the packaging industry which is characterized by a high innovativeness. Hence, the pharmaceutical market shows more and more intelligent packages which have smart closures, special properties, etc. The example may be the simplest packaging of eye drops, utilizing a mechanism of non-sucking the air inside of the packaging what makes that dosage of the drops is more precise: after squeezing the bottle, only one drop flows out from the bottle. Another type of the closure which is more and more frequently employed in the containers of pills: they contain only the caps with the protection of Child Resistant type. Owing to this arrangement, a small child, for whom a given substance is harmful, will have a problem with opening of the discussed

packaging. To remind the patient about the daily dose of the drugs, there are installed the closures with electronic micro-circuits, strictly controlling the date and time of each opening and closure of the packaging, and with LCD display, showing the number of doses, taken on a given day [2]. Such solution allows also the physician to control whether a patient followed his recommendations.

The application of automatic pens, i.e. automatic injectors becomes also more and more popular. It is connected with the increase of the number of adult diabetics all over the world. At present their number is equal to ca. 415 million persons and until 2040, the mentioned number is expected to reach 642 million cases [3]. Such alarming data cause greater demand on insulin and its appropriate packaging. It may be administrated in ampoules, using a syringe, and also, pens may be used with a ready-to-use cartridge. The pharmaceutical industry follows this way. The mentioned cartridge is sealed with the rubber stopper at the end part; from the front part, there is an aluminium membrane which may be punctured by the needle before administration of the medicinal product. The discussed device is also supplied with an easy-to-use dosing mechanism which facilitates injection of the appropriate volume of insulin. Another innovation in respect of drug therapy includes automatic injectors which replace long-lasting waiting for visit at doctor's room in the case of rare oncologic or hormonal diseases [3]. Owing to the discussed solutions, the patients may become more independent and, moreover, they can save their time and stress.

Marking of the packaging is a significant factor of packaging production. In the case of medicinal products, it is especially important to protect them against adulteration or falsification. Owing to the appropriate marking, it is possible to trace a given product and control whether it reached its target. The systems such as track and trace, or UDI, i.e. unique system for identification of devices, are most frequently used, for example, for tracing the route of dispatched parcels. Pigments Iriotec 8000 are the interesting technology of marking the packaging. They are adapted to UDI system and require only pigment and appropriate laser which makes that the marking becomes more stable [4]. The discussed technology is characterized by a high level of contrast and contact-free processes. It may be employed on delicate, curved surfaces such as certain pharmaceutical packages. Nowadays, the era of applying the holograms and special closures as the method for protection of the product against fraud is passing away. Pharmaceutical industry moves rather towards the application of RFID (radio-frequency

identification) micro-tags and invisible or miniaturized overprints. At present, the producers are also focusing their attention on emphasizing the integrity of packaging in connection with the Falsified Medicines Directive/2011/62/EU, published on 1 July 2011 and applied since 2 January 2013 [2]. According to the mentioned document, the prescription medicines bear the unique number and the element, preventing the earlier opening; it allows the pharmacists to verify whether a given product is really intact. The on-line pharmacies are marked with one logo, owing to which the number of falsified medicines sold in the Internet has been limited.

The most significant properties of pharmaceutical packaging

To examine the preferences of the users of pharmaceutical packaging, the survey was carried out among 100 persons at different age and with different education level. It allowed obtaining information what are the properties and types of pharmaceutical packaging which are most important and convenient from the viewpoint of its user. The answers of the respondent are given in Tables 1–5 and Fig. 1.

Table 1 contains the presentation of the answers to the question concerning the features of pharmaceutical packaging.

From the results of the below survey it is followed that safety of pharmaceutical packaging is the most important factor. Eco-friendliness of the mentioned packaging is the least significant aspect.

Table 2 presents the answers concerning the mentioned above question but considering gender of the respondents.

On the grounds of the obtained results we may state that women were mostly focused on readability of information and

Table 2. The averaged results of the respondents' answers to the question: "what properties of pharmaceutical packaging are most significant in your opinion?" according to gender

Gender	Women	Men
Number of respondents	52	48
Eco-friendliness	3.45	3.39
Graphical form	3.83	3.62
Safety	3.94	4.03
Readability of information	4.02	3.61
Possibility of complete emptying	3.63	3.22
Convenience of use	3.89	3.33

Table 1. The averaged results of the respondents' answers to the question: "what properties of pharmaceutical packaging are most significant in your opinion?"

Number of respondents	Eco-friendliness	Graphical form	Safety	Readability of information	Possibility of complete emptying	Convenience of use
100	3.4	3.71	4	3.75	3.6	3.55

Table 3. The averaged results of the respondents' answers to the question: "what properties of pharmaceutical packaging are most significant in your opinion?" according to age

Age	<18 years	18-25 years	26-35 years	36-45 years	45-60 years	>60 years
Number of respondents	9	43	13	20	9	6
Eco-friendliness	3.16	3.66	3.88	3.93	3.29	3.20
Graphical form	3.25	3.21	3.35	3.16	3.48	3.39
Safety	3.4	3.67	3.58	3.57	3.79	3.59
Readability of information	3.3	3.77	3.28	3.47	3.75	3.73
Possibility of complete emptying	3.3	3.62	3.81	3.24	3.81	3.29
Convenience of use	3.88	3.99	3.6	3.8	4.02	3.86

safety of packaging; eco-friendliness was evaluated at the last place. Men paid their greatest attention to the safety of packaging whereas the possibility of complete emptying was the least important aspect for them.

Table 3 contains the results considering the age of the respondents.

From the results of the survey studies, it may be followed that the eco-friendliness of the pharmaceutical packaging is the most important aspect for the persons at the age of 36-45 years whereas for the persons below 18 and more than 60 years, it is the least significant factor. Graphical form is most important for the users at the age of 45–60 years and least meaningful for the respondents at the age of 36–45 years. The safety of pharmaceutical packaging occurred to be the most important aspect for the persons at the age of 45–60 years whereas for the users at the age under 18 it is least important. The readability of information is most important for the persons at the age of 18 – 25 years and above 45 and least important for the respondents at the age below 18. The possibility of complete emptying of the packaging is the most significant factor for the persons at the age of 26–35 years and 45–60 years. The mentioned aspect is least important for the respondents above 60 years of life. The convenience of use is the most important feature of pharmaceutical packaging for the users at the age of 18–25

years and the least important aspect for the persons at the age of 26–35 years of life.

Table 4 shows the results of the survey studies, considering the level of education of the respondents.

For the persons without education, the convenience of use of pharmaceutical packaging is its most important aspect and its eco-friendliness and graphical form are the least significant factor. For the persons with the primary education, the eco-friendliness of packaging is most important and its graphical form is the least significant aspect. The persons with vocational education appreciate the readability of information of the packaging as the most important factor; on the other hand, the graphical form and convenience of use is the least meaningful factor for them. The persons with secondary education pay mostly the attention to the eco-friendliness of packaging and the possibility of their complete emptying is for them the smallest problem. For the persons with the higher incomplete education, the graphical form and the possibility of complete emptying of the packaging are the most important factors. The convenience of use is the least significant factor for this group. The persons with the higher education pay the greatest attention to the readability of information and graphical form of the packaging is the least important aspect for them.

Table 4. The averaged results of the respondents' answers to the question: "what properties of pharmaceutical packaging are most significant in your opinion?" according to education level

Education	Lack	Primary	Vocational	Secondary	Incomplete higher	Higher
Number of respondents	7	6	7	19	32	29
Eco-friendliness	3.28	4.02	3.79	4.03	3.67	3.75
Graphical form	3.26	3.36	3.23	3.22	3.81	3.24
Safety	3.96	3.83	3.61	3.97	3.42	3.83
Readability of information	3.73	3.49	3.97	3.90	3.36	4.01
Possibility of complete emptying	3.99	3.41	3.39	3.38	3.82	3.59
Convenience of use	4.07	3.6	3.29	3.78	3.43	3.47

The most satisfying types of pharmaceutical packaging

In this part of the survey, the responders indicated the types of pharmaceutical packaging which were most satisfying for them. The question was not obligatory, so not everybody respondent answered this issue. It was dictated by the fact that not everybody used the submitted types of packaging. The answers of the respondents were given in Tab.5 and Figure 1.

Table 5. Numerical presentation of the respondents' answers to the question: "Which types of the pharmaceutical packaging are most satisfying for you?"

Type of packaging	Number of respondents	Mean evaluation
Sachets with a powder to be dissolved	96	4.00
Cardboard box	98	3.67
Blister sold separately	91	3.43
Plastic container with a cap	99	3.00
Plastic tube with a cap	100	3.93
Aluminium tube with a cap	93	2.89
Glass bottle with a cap	96	3.43
Glass bottle with a drop feeder	94	3.53
Ampoules	61	3.70
Laminated tubes	92	4.01
Pre-filled syringe	42	3.72

The sachets with the powder to be poured to water and dissolved and laminated tubes are the most satisfying type of pharmaceutical packaging for the respondents. On the other hand, they put the aluminium tubes with caps and plastic

containers for pills at the last place of evaluation. 58% of the respondents do not use pre-filled syringes and 39% do not use ampoules.

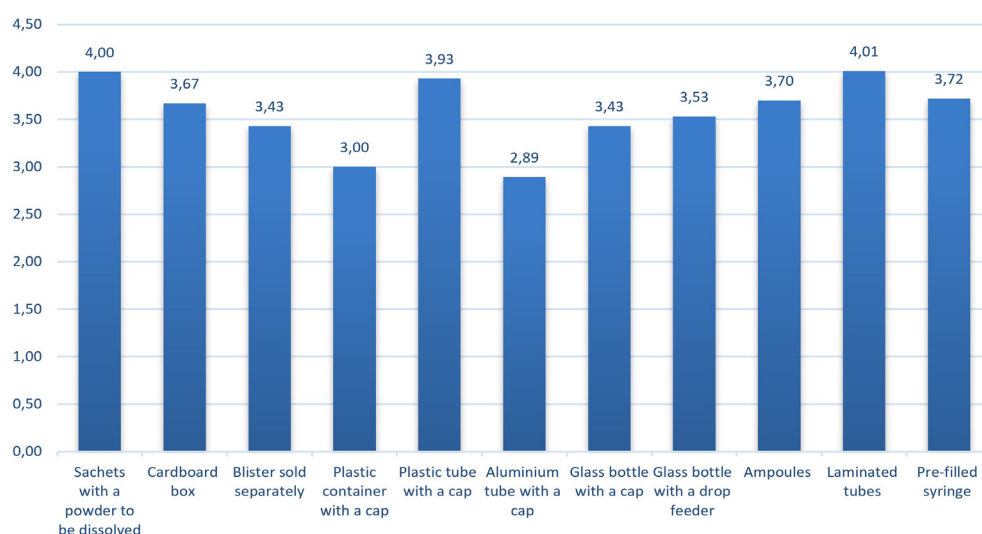
Summing up and conclusions

The results of the studies indicate that the respondents pay the greatest attention to the **safety of the pharmaceutical packaging**. Their **eco-friendliness** occurred to be the least important factor. The respondents recognized **the sachets with the powder to be poured** and **laminated tubes** as being the most satisfying pharmaceutical packaging. They are the most convenient packaging. It is enough to tear a sachet and pour the powder to water; the tubes can be opened and closed many times. Moreover, the tablets wrapped in the mentioned tubes are arranged one after another, so their removal is quite convenient. The respondent evaluated the **aluminium tubes with caps** and the plastic **containers for the pills** at the last place. It was also revealed that 58 % of the respondents did not use pre-filled syringes and 39% did not use ampoules.

From the above considerations, it is followed that pharmaceutical sector is vigorously developing. Nowadays, when we speak so much about the effect of waste on the natural environment, the answers of the respondents, who chose the eco-friendliness of pharmaceutical packaging as the least important aspect, are surprising. It may be concluded that the packaging which is practical, safe and easy in everyday use, is most popular. The introduction of innovative packaging to the market is undoubtedly a specific challenge to the designers and producers. The created packaging should simultaneously meet the requirements of the users and satisfy the eco-promoting legal regulations.

Bibliography

Fig.1. The column form of presentation of the respondents' answers to the question: "Which types of the pharmaceutical packaging are most satisfying for you?"



- [1] Ustawa z dnia 6 września 2001 r. Prawo farmaceutyczne
- [2] Wasiak W. i inni, Kierunki rozwoju opakowań. Wybrane problemy. Monografia., Warszawa, 2014
- [3] Mali pomocnicy – duże efekty, Packaging Polska 10/2019, str. 20-21
- [4] Jak dotrzymać kroku? Packaging Polska 10/2019, str. 26-27

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