MEASURING SYSTEMS

ANALYSIS OF COMPLIANCE BY FOOD ENTERPRISES WITH REGULATIVE REQUIREMENTS FOR PACKAGED GOODS

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Abstract

The article presents the results of measuring the contents of consumer packages of two types of food products: carrot puree for baby food from three different brands and white crystalline sugar from two manufacturers. The studied samples of food products were randomly selected from retail outlets in Minsk (Belarus). The measurement results showed that the actual weight of the selected samples exceeded the nominal weight established for the packaging units of these products, but did not exceed the permissible upper limit. It was also found that no more than 10% of samples of carrot puree for baby food of two brands had a net weight lower than the nominal one, but after carrying out the appropriate calculations they were not classified as defective units. Based on the analysis of the results obtained, it was concluded that national legislation in the field of packaged goods was observed.

Keywords: packaged goods, measurement, net weight, minimum permissible weight, defective unit.

Introduction. In recent decades, the level of sales of packaged goods has increased significantly due to the significant simplification of their transportation and sale compared to products, the quantity of which must be determined in the presence of the buyer. Currently, about 95% of goods in stores are packaged foods. These include a wide variety of goods, for example, food products, drinks, perfumes and cosmetics, household chemicals, paints, fertilizers, etc. The purchase and sale of goods is based on consumer trust in the quality and safety of products. An important parameter for the consumer in relation to packaged goods is their quantity. When purchasing packaged goods, the buyer cannot monitor the packaging process and control the measurement process. In relation to packaged goods, we are talking about measurements of mass, volume, density, length, area, number of pieces. At the same time, product compliance with legal requirements directly depends on the measurement results and providing conditions for achieving public confidence in their results [1, 2].

Since manufacturers, importers and sellers of most products are responsible for the measurement processes, buyers who typically do not have adequate information about the processes for obtaining and interpreting measurement results are potentially at a disadvantage. Consequently, conditions are created for the occurrence of actions that mislead consumers and the protection of their rights is not ensured. In this regard, it is of interest to conduct research aimed at ensuring compliance by domestic food enterprises with domestic regulatory requirements for packaged goods.

It is obvious that any product goes through a number of development stages from creation to disposal, the sequence of which is called the product life cycle. One of the most important stages of this cycle is the packaging stage, which allows you to maintain the quality and properties of the product throughout its shelf life and storage. Packaging refers to the operations performed to house, protect, move, deliver, store, transport and display goods (raw materials and finished products) by the manufacturer, user or consumer. The result of the packaging process is packaged goods, i. e. consumer goods in packages of any kind that are packaged, packaged and sealed in the absence of the buyer in such a way that the contents of the package cannot be changed without opening or damaging it, and the weight, volume, length, area or other quantities indicating the quantity of goods contained in the package, are indicated on the packaging [3, 4].

The choice of packaging method is influenced by a number of factors, the main of which are the type of product being packaged and its properties; material, shape and design of packaging; Packaging equipment. There are several types of food packaging, such as aseptic, vacuum, hermetic packaging; packaging in heat-shrinkable wrapping material (shrink film) and in a modified gas environment [4].

In recent years, aseptic packaging of food products has received great development in the field of packaging products, providing for separate sterilization of products and packaging, packaging of processed products in aseptic packaging and sealing under sterile conditions. This prevents rapid deterioration of the product and ensures a long shelf life without the use of preservatives. This type of packaging is widely used for liquid food products (dairy, juice products, pastes, etc.). To eliminate the harmful effects of oxygen during the storage of many food products, which leads to undesirable chemical and microbiological changes, various techniques are used, the most accessible of which is vacuum packaging. Vacuum packaging is carried out at sub-atmospheric pressure, removing air from the package, after which it is sealed. Hermetic packaging is a process of packaging products, the purpose of which is to prevent contact of the product with air and water in order to avoid its spoilage or changes in properties. When

packaging in shrink film, the product is wrapped in material and the packaging is formed by welding the seams and then shrinking, i.e. under the influence of temperature, the film contracts and tightly fits the product wrapped in it. For packaging fresh vegetables and fruits, culinary, bakery and confectionery products, packaging with a modified composition of the gas environment is used. Packaging in a modified gas environment allows you to extend the shelf life and storage of perishable food products by creating a gas environment inside the package that is optimal for each type of product [2–4].

Thus, packaging is the final stage of the technological process of manufacturing any type of product and is usually carried out directly at the enterprise. Packaging in consumer packaging generally consists of the following steps:

– supply and preparation of packaging and packaging materials;

– supplying the product and filling the packaging with it;

– capping;

– design of packaging units;

– quality control of packaged goods.

Each of the above stages consists of several sequential operations that are performed on technological equipment containing corresponding actuators and mechanisms. At the end of the packaging process, a quality check of packaged products is carried out, which may consist of various procedures depending on the product, type of packaging and packaging method, for example, monitoring the integrity of the packaging; checking the markings; determination of filling level; counting the number of product units in a package; weighing.

Obviously, it is important for the consumer to receive a certain amount of high-quality and safe products. If the quantity of products in the package is less than the established quantity, this will naturally cause dissatisfaction with the consumer, because he receives less than he paid for and intended to receive. Therefore, controlling the quantity of packaged goods is an important stage of the packaging process and is necessary to identify discrepancies between the actual quantity and the nominal quantity, i.e. indicated on the packaging. Control is carried out by legal entities and individual entrepreneurs manufacturing, importing, selling packaged goods or packaging goods, as well as state supervisory authorities (state metrological control). To ensure that the packaging process is carried out accurately and the consumer receives the quantity of packaged goods indicated on the packaging, relevant legislative and regulatory documents are in force, the main purpose of which is to ensure the protection of the interests and rights of consumers.

Thus, in the European Union, to simplify the free movement of packaged goods, general rules have been adopted, published in the relevant Directives (Directive 75/106/EEC of January 20, 1976 “On the approximation of the legislation of the EU Member States regarding the packaging of certain liquids in accordance with their volume in packages of any kind”; Directive 76/211/EEC of January 20, 1976 “On the approximation of the legislation of the Member States with regard to the packaging of certain products according to their weight or volume in packages of any kind”; Directive 80/232/EEC of January 15, 1980 “On the approximation of the legislation of the EU Member States in terms of establishing preferred values for the nominal quantity of goods and the nominal capacity of containers used for packaging certain types of goods in packages of any type”).

Despite the fact that the EU is the “pioneer” in establishing uniform requirements for packaged goods, at the present stage, the International Organization of Legal Metrology (OILM) is primarily concerned with issues of legal and technical regulation in the field of standardization of requirements for the quantity of packaged goods. This organization has developed the following recommendations regarding packaged products: OIML recommendations OIML R 79:2015 “Requirements for labeling of packaged goods”; OIML recommendations OIML R 87:2016 “Quantity of packaged goods”; OIML G 21:2017 “Guidelines for the determination of requirements for a certification system for packaged goods”. In accordance with the OIML Convention, national regulations establishing metrological requirements and control provisions regarding the quantity of packaged products should, to the maximum extent possible, be based on international OIML recommendations [5]. In Belarus, there are terminological standards (GOST 16299-2022 [6], GOST 17527-2020 [7],

GOST 32180-2022 [8]) and standards establishing requirements for the quantity of packaged goods (STB 8019-2002 [9]) and for monitoring the quantity of goods (STB 8020-2002 [10], which is harmonized with the OIML Recommendations and EU Directives, and STB 8035-2012 [11]).

Aim. Thus, the purpose of our study was to analyze the compliance of food enterprises with regulatory requirements for packaged goods.

Materials and methods. To achieve this goal, we selected food products packaged in different consumer packages (Table 1).

Table 1

Brief description of the research objects

Name of product*	Type of packaging	Nominal weight, kg	Number of samples
1	2	3	4
Carrot puree for baby food for young children, homogenized, sterilized "Bellakt"	Glass jar PT 100	0,100	15
Carrot puree for baby food for young children, homogenized, sterilized "Toptyzhka"	Glass jar PT 190	0,190	15
Carrot puree for baby food for young children, homogenized, sterilized "Fidget"	Glass jar PT 100	0,095	10
White crystalline beet sugar (manufacturer 1)	Paper bag	1,000	15
White crystalline beet sugar (manufacturer 2)	Paper bag	1,000	13

Note. * Study objects within the same group differ in date of manufacture and production shift.

Determination of the mass of packaged goods by weighing the product was carried out in accordance with [11] (Figure 1), observing the following environmental conditions: temperature - (20±1) ºC; relative humidity – (55±1) %.

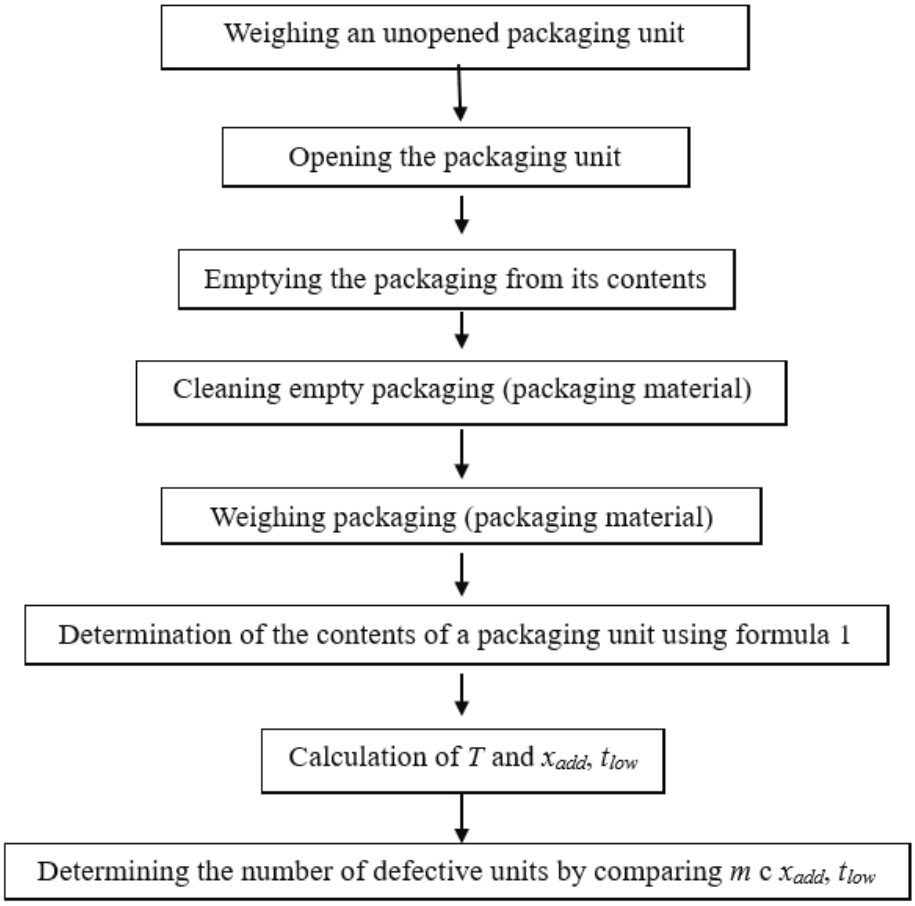

Figure 1 – Schematic representation of the procedure for determining the mass of a packaging unit

The following calculation formulas were used in the work:

– the average (arithmetic mean) value of the package mass $\bar{m}_{pack}$ was calculated using the formula:

$$\bar{m}_{pack} = \frac{\sum_{i=1}^{n} m_{pack,i}}{5}, \quad (1)$$

where $m_{pack,i}$ is the value of the mass of the *i-th* package, g (kg).

– the contents of each packaging unit (weight of packaged goods) m_i were calculated using the formula:

$$m_i = m_{gross,i} - \bar{m}_{pack} \quad (2)$$

where $m_{gross,i}$ is the weight value of the *i-th* unopened packaging unit (gross weight), g (kg);

$\bar{m}_{pack}$ is the average value of package mass determined by (1), g (kg).

– the minimum permissible value of the contents of the packaging unit x_{add} and the value of the lower control limit of the negative deviation of the contents t_{low} are calculated using the formulas:

$$x_{add} = K_{nom} - T, \quad (3)$$

$$t_{low} = K_{nom} - 2T, \quad (4)$$

where K_{nom} is the nominal weight of packaged goods, g (kg);

T – limit of permissible negative deviations of the contents of a packaging unit from the nominal weight in accordance with Technical Specification for specific type of product and [9].

If the actual value of the quantity of a packaged product is less than the minimum permissible value of the contents of the packaging unit x_{add}, then such a product is considered defective. If the contents of the packaging unit are less than the lower control limit of the negative content deviation t_{low}, then the entire batch of packaged goods is rejected.

To weigh the objects of study and obtain the gross mass value, we used commercial scales MK-6.2-A21; the permissible error limit of these scales during operation is:

– in the weighing range from 0.02 to 0.5 kg (inclusive) – ±1.0 g;

– in the weighing range from 0.5 to 2.0 kg (inclusive) – ±2.0 g.

To weigh packaging (glass jars and paper bags) and some puree samples, a Radwag PS 1200/C/2N laboratory scale was used, the permissible error limit of which is ±50.0 mg when weighing up to 500 g.

Results and discussion. Calculations of the net mass of the research objects are presented in Figures 2–6.

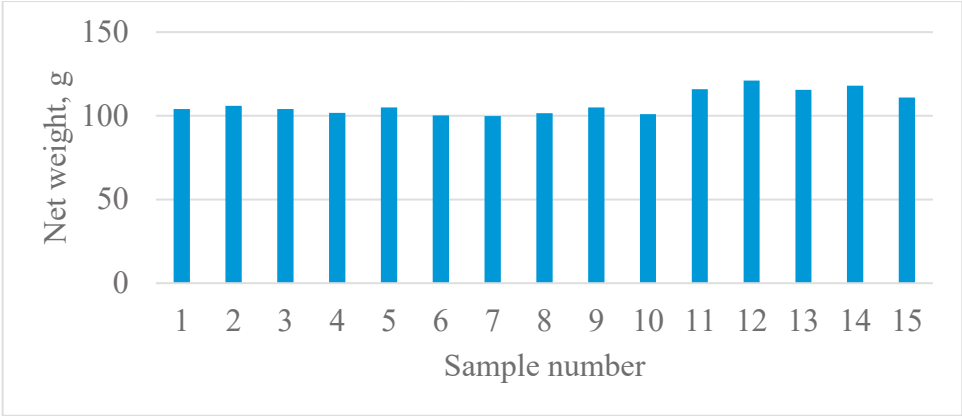

Figure 2 – Net mass values of 15 samples of carrot puree for baby food "Bellakt" (packaging – glass jar PT 100), manufactured between November 2022 and October 2023 (nominal mass – 100 g)

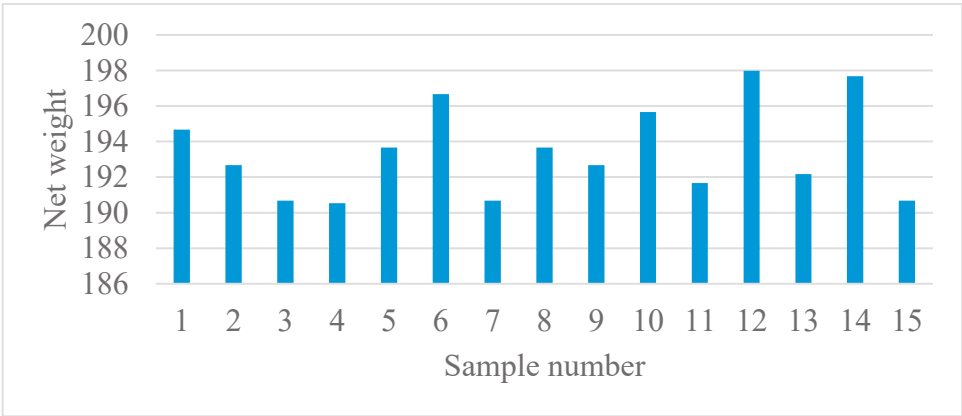

Figure 3 – Net mass values of 15 samples of carrot puree for baby food "Toptyzhka" (packaging – glass jar PT 190), manufactured between April 2023 and September 2023 (nominal mass – 190 g)

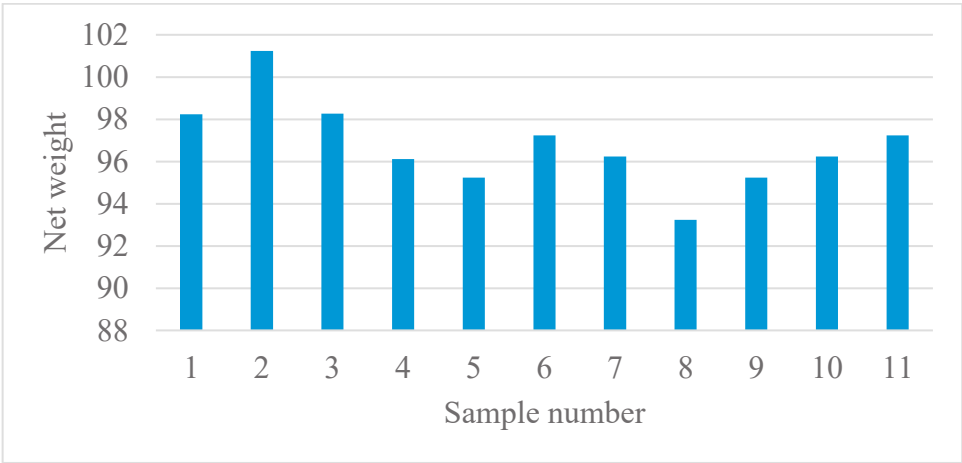

Figure 4 – Net mass values of 11 samples of carrot puree for baby food "Fidget" (packaging – glass jar PT 100), manufactured between August 2022 and September 2023 (nominal mass – 95 g)

Analysis of the data presented in Figures 2–4 indicates that the net weight of the samples of carrot puree of different brands studied by us, as a rule, exceeds the nominal weight. The exceptions were two samples: sample No. 7 of Bellakt carrot puree (net weight 99.83 g) and sample No. 8 of Neposeda carrot puree (net weight 93.23 g). In order to qualify the specified samples of carrot puree as defective units, it is necessary to compare the net mass values with the minimum permissible value of the contents of the packaging unit x_{add} (Table 2).

Table 2

Calculation results of the permissible mass of a packaging unit

Object	K_{nom}, g	T, g	x_{add}
Carrot puree for baby food “Bellakt”	100	4,5	95,5
Carrot puree for baby food “Fidget”	95	4,5	90,5

From the data in Table 2 it is clear that samples No. 7 and No. 8 have an actual mass exceeding the x_{add} value and do not belong to defective units.

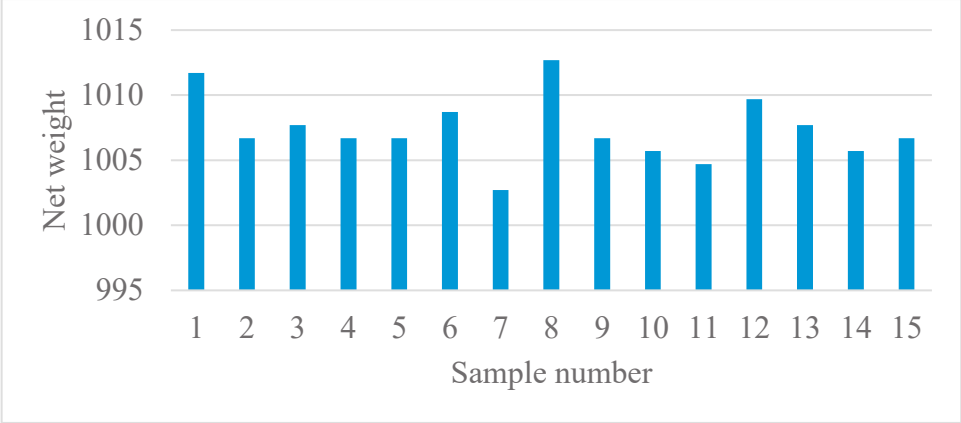

Figure 5 – Net mass values of 15 samples of white crystalline beet sugar (manufacturer 1) (packaging – paper bag), manufactured between December 2022 and December 2023 (nominal mass – 1000 g)

The results of measurements of the net weight of white sugar samples (Figures 5, 6) indicate that the packaging equipment used by manufacturers is configured in such a way as to ensure an acceptable excess of the nominal weight of the product in the packaging unit.

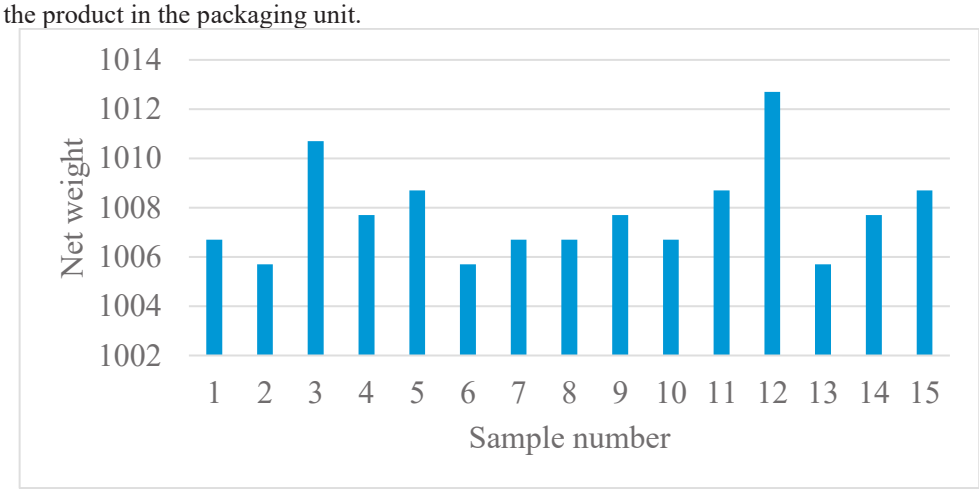

Figure 6 – Net mass values of 15 samples of white crystalline beet sugar (manufacturer 2) (packaging – paper bag), manufactured between February 2023 and December 2023 (nominal mass – 1000 g)

Conclusion. Our analysis of the regulatory framework in the field of packaged goods and our own research in terms of measuring the net mass of samples of various food products packaged in consumer packaging allow us to draw the following conclusions.

1. In Belarus, to prevent misleading consumers regarding the quantity of goods (product), national standards have been developed and applied that contain requirements for permissible positive and negative deviations from the nominal weight of the product in a packaging unit.

2. Randomly selected samples of food products from different manufacturers, standard sizes and types of consumer packaging have an actual weight that exceeds the nominal weight within acceptable deviations.

3. Among similar products (carrot puree for baby food) of different brands manufactured during the year, packaging units with a net weight less than nominal were 6.7% (carrot puree for baby food “Bellakt”) and 8.3% (carrot puree for baby food “Fidget”).

4. Calculations of the minimum permissible value of the contents of a packaging unit for these products

proved that the manufacturer did not violate national legislation in the field of packaged goods.

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