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VALIDITY TESTS OF THE METHODS USED FOR THE INVESTIGATION OF AIR-TIGHTNESS OF
SEMI- SOLID CONTAINERS

Meat as well as the other food are sterilized in the increased amounts in containers produced from aluminum foils with lacquered surfaces or coated with plastic films. Air-tightness checking of tins closed by double seams is well known. However, methods for air-tightness checking of containers with welded seams between the cover and base are much less studied. This paper is dealing with the validity tests for the three methods used for the discovery of those containers which proved not to be air-tight. Method for lacquer and aluminum dissolution as well as the method of heating and vacuum have given approximately the same results, while the results obtained by microbiological method is considerably poor. Method of heating and vacuum under the conditions of industrial processin of meat proved to be extremely practical being accurate and simple.

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WERTPRÜFUNG VON METHODEN DER LUFTDICHTUNGERFORSCHUNG HALBFESTER CONTAINER

Inhalt

Das Fleisch und andere Nahrungsmittel werden in immer grösseren Mengen sterilisiert in Gefässen, die durch Verarbeitung von Aluminiumfolienrollen und Bändern geformt werden, deren Flächen entweder lackiert oder mit plastischen Folien bedeckt sind. Die Luftdichtungsprüfung der durch doppelte Naht geschlossenen Dosen ist gut bekannt. Weit weniger sind die Methoden der Luftdichtungsprüfung bei Container erforscht, bei denen die Naht des Körpers und des Deckels durch Schweissen geformt wird. Während der Arbeit wurden die Werte von drei Methoden geprüft, durch deren Anwendung die nicht hermetischen Container entdeckt werden konnten. Die Methode der Lack- und Aluminiumauflösung und die Wärme- und Vakuummethode haben beinahe gleiche Ergebnisse vorgezeigt, während die durch Mikrobiologiemethode gewonnenen Ergebnisse bedeutend schwächer sind. Die Wärme- und Vakuummethode bewährt sich aussergewöhnlich gut in den Bedingungen der Fleischindustrieverarbeitung, weil sie genau und einfach ist.

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VERIFICATION DE LA VALEUR DES METHODES D'EXAMEN DES CONTAINERS SEMIS SOLIDES

La viande et les autres produits alimentaires sont stérilisés en quantités de plus en plus grandes dans des récipients formés par la préparation des rouleaux des feuilles d'aluminium et des bandes dont les surfaces sont vernises ou couvertes des feuilles plastiques. La vérification de l'herméticité des boîtes fermées par double soudure est bien connue. Beaucoup moins explorées sont les méthodes de vérification de l'herméticité des containers dont la soudure du corps et du couvercle est faite par soudage. Dans cet ouvrage sont vérifiées les valeurs de trois méthodes par l'utilisation desquelles on pourrait découvrir les containers non hermétiques. La méthode de dissolution du vernis et de l'aluminium, la méthode de chaleur et de vide, ont données presque les mêmes résultats, pendant que les résultats obtenus par la méthode microbiologique sont beaucoup plus faibles. La méthode de chaleur et de vide, dans les conditions de préparation industrielle de la viande, est particulièrement favorable puisqu'elle est précise et simple.

Проверка значений получаемых методом исследования герметичности полупрочных контейнеров

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Мясо и прочие пищевые продукты все в большем количестве стерилизуются в посудах сформированных переработкой рулонов алюминиевой фольги и лент поверхностно лакированных или облагаемых пластмассовой фольгой. Проверка герметичности жестяных банок закрываемых двойным швом широко известна. Но, намного меньше изучены методы проверки герметичности контейнеров у которых шов посуды и крышки формируется сваркой. В процессе работы проверялись значения тремя методами применением которых могли бы найти негерметичных контейнеров. Метод растворимости лака и алюминия и метод теплотой и вакуума давали приблизительно одинаковых результатов; результаты полученные микробиологическим методом значительно хуже. Метод теплотой и вакуума в условиях промышленной мясной переработки очень удобен, так как дает верные результаты а способ исследования простой.

Validity tests of the methods used for the investigation
of air-tightness of semi-solid containers

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Meat and other foodstuffs are in ever increasing quantities sterilized in semi-rigid containers. They are produced from aluminium foil strips being varnished or laminated with plastic film. Like the can leakage, leakage of aluminium containers is the cause of canned product spoilage. Testing of can leakage has been investigated as yet /Suvakov and Trumić, 8; Oluški et al., 4; Tadić Zivka et al., 9; Kelch and Hadlok, 2 and others/. For many years already the procedures have been used in the everyday practice of industrial meat processing. However, methods for testing the leakage of containers which body and end seams are formed by thermosealing, have been far less investigated. This problem is now more and more intensively examined /Effenberger and Schotte, 1; Oluški Ana et al., 5; Pospíšil, 6; Schmidt-Lorenz, 7; Tändler, 10 and 11/. Since a sufficiently sure and simple method for testing the leakage of semi-rigid containers has not been developed so far, we examined three procedures published in the course of a few past years.

Techniques

The product "Mesni obrok" /minced meat/ was tested for leakage because the swelling of this product was exceptionally frequently observed in shops. The stuff was filled in semi-rigid aluminium containers. The prepared cans were of the following weights: 0.075, 0.100 and 0.150 kg. Number of examined samples and production lots, dependent on the can weight, are presented in Table 1.

Table 1

Can designation /production lot/	Net weight kg	Examination by the method		
		1.	2.	3.
02261	0,075	20	20	20
02262	0,075	20	20	20
02263	0,075	20	20	20
02261	0,100	15	15	15
02262	0,100	15	15	15
02263	0,100	15	15	15
02361	0,150	13	13	13
02362	0,150	13	13	13

Before bacteriological examination, the cans were incubated for 10 days at 37°C. However, the leakage of containers was tested without previous incubation, using the method of varnish and aluminium foil dissolution /N.N., 3/ and the method of heat and vacuum /Ana Oluški et al., 5/.

Examination methods

1/ Method of varnish and aluminium foil dissolution /N.N., 3/. - After cutting off the container seam, the varnish is removed by means of concentrated sulphuric acid /H₂SO₄/. Afterwards, aluminium is dissolved by immersion into hydrochloric acid (HCl) or into sodium hydroxide /NaOH/. The sealed plastic foils are washed and dried. A few drops of the solution of a suitable colour are introduced into the sealed joint by means of a pipette or injection needle. After ten minutes, in transmitted light or under microscope, it is established whether the seam is good or not. Coloured spots prove the leakage of seam.

2/ Heat and vacuum method /Ana Oluški et al., 5/. - Cans weighing up to 150 g are heated for 10 minutes at 90°C, the air being then exhausted for 2 minutes at 600 mm Hg. The leakage is shown by the content coming out from the container or by visible delamination of the seam.

3/ Microbiological method. - Method No. 3 prescribed in the "Regulations covering the minimum conditions regarding the bacteriological soundness of foodstuffs in trade", Sl. list SFRJ No. 55/1973.

Results and discussion

Table 2 presents the examination results established by method 1.

Table 2.

Can weight	Can designation	Number of examined cans	Number of hermetically sealed	% of hermetically sealed	Number of not hermetically sealed	% of not hermetically sealed
0,075	02261	20	13	65	7	35
	02262	20	17	85	3	15
	02263	20	14	70	6	30
0,100	02261	15	13	87	2	13
	02262	15	10	67	5	33
	02263	15	12	80	3	20
0,150	02361	13	9	69	4	31
	02362	13	10	77	3	23
TOTAL		131	98	74,81	33	25,19

From the results presented in Table 2, it can be seen that from a total of 131 examined cans, 33 were not hermetically sealed, namely 25.19%. Not hermetically sealed cans were found in all weight groups and in all production lots.

Similar results were obtained by the use of method 2, as shown by the results presented in Table 3.

Table 3.

Can weight	Can designation	Number of examined cans	Number of hermetically sealed	% of hermetically sealed	Number of not hermetically sealed	% of not hermetically sealed
0,075	02261	20	15	75	5	25
	02262	20	11	55	9	45
	02263	20	19	95	1	5
0,100	02261	15	12	80	3	20
	02262	15	8	53	7	47
	02263	15	12	80	3	20
0,150	02361	13	10	77	3	23
	02362	13	10	77	3	23
TOTAL		131	97	74,05	34	25,95

Bacteriological evaluation of leakage was performed on the basis of the shelf life test of products held for 10 days at 37°C and the bacteriological analysis of incubated samples. The results are presented in Tables 4 and 5.

Shelf life test

Table 4.

Can weight	Can designation	Number of incubated samples	Number of unchanged samples	Number of swelled samples	% of swelled samples
0,075	02261	75	74	1	1,3
	02262	75	75	0	0
	02263	75	75	0	0
0,100	02261	75	71	4	5,3
	02262	75	71	4	5,3
	02263	75	75	0	0
0,150	02361	75	75	0	0
	02362	75	75	0	0
TOTAL		600	591	9	1,5

Bacteriological examination

Table 5.

Can weight	Can designation	Number of examined samples	According to conditions of article 14 of Regulations acceptable	unacceptable
0,075	02261	20	17	3
	02262	20	17	3
	02263	20	20	0
0,100	02261	15	14	1
	02262	15	15	0
	02263	15	11	4
0,150	02361	13	11	2
	02362	13	12	1
TOTAL		131	117	14

On the basis of the results presented in Table 4, only 1.5% of swelled cans was established. If 9.16% of bacteriologically examined and found to be contaminated cans are added /Table 5/, it can be concluded that 10.66% of samples are bacteriologically unsound.

By the method of varnish and aluminium foil dissolution /N.N., 3/ and the heat and vacuum method /Oluški Ana et al., 5/, a high percentage of not hermetically sealed cans was revealed: 25.19% namely 25.95% /Tables 2 and 3/. Incubation is an unsure procedure for the establishment of leakage. By this method, only 1.5% of not hermetically sealed cans was established - incomparably less than by methods 1 and 2. When incubated cans are also bacteriologically examined, somewhat more realistic picture is obtained /Table 6/. In relation to the first two methods, bacteriological method is not only less sure but it also lasts longer and is more expensive and for these reasons it cannot be accepted as a routine procedure. The results of Pospišil /6/ and Schmidt-Lorenz /7/ also confirm that bacteriological methods are not suitable for the determination of leakage of semi-rigid containers.

Although equal to heat and vacuum method regarding the obtained results, the method of varnish and aluminium foil dissolution will not be frequently used in practice because it is more expensive. This procedure can be carried out only by skilled personnel and in correspondingly equiped laboratories. The heat and vacuum method can also be used for testing the leakage of containers during the production process - prior to sterilization of cans.

Conclusion

On the basis of the examination results, the following can be concluded:

By the method of varnish and aluminium foil dissolution and the heat and vacuum method, contrary to bacteriological method, a high percentage of not hermetically sealed cans the content of which is closed and sterilized in semi-rigid containers is revealed.

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