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Factors are Affecting Tin Released in Canned Beverages

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Abstract : Factors that affect the dissolution of metals from the cans body can occur and influenced by cans material, duration and conditions of storage, acidity of the contacting foodstuff. The objective of this research is to determine the effect of pH when it released from tin in beverages and to determine the expiration date of it effect. This research method is Causal Comparative, the sample used canned beverages were carbonated beverages, beer and juice. Research conducted on pH canned beverages, label views expired canned beverages, tin assay using atomic absorption spectrophotometer air-acetylene flame at wavelength 286.3 nm. The results showed the differences of average levels on tin released in carbonated canned beverages, beer, and juice, statistically. Tin levels ($mgkg^{-1)}$ canned beverages expired in 2014 A1, A2, A3, B1, B2, B3, C1, C2, C3 brand respectively are: 5.7676±0.1631, 5.2412±0.3730, 4.4737±0.3063, 3.6623±0.3470, 3.6184±0.3285, 3.5965±0.4033, 4.3421±0.1938, 3.9473±0.2739, 3.8158± 0.3874, expired in 2015, respectively: 2.8948±0.6425, 2.8290± 0.4491, 2.8070±0.7206, 2.6096±0.7678, 2.5658±0.6815, 2.5000±0.5648, 2.7632±0.3874, 2.7193±0.5259, 2.7124±0.1704. The conclusion is when pH is lower tin released level is higher. When the expired date is longer tin released is lower. Tin levels in canned beverages are eligible that have been set by the WHO / FAO and the European Union according to EC 1881/2006 the maximum limit of 200 $mgkg^{-1}$ for tin in canned food than beverages must be 100 $mgkg^{-1}$ including fruit and vegetable juices and 50 $mgkg^{-1}$ for baby food.
Keywords: Canned Beverages, pH, Expired, Tin, Atomic Absorption Spectrophotometer.

Introduction

Canned beverages is packaged on small metal container to extend the life of the beverage, ready-to-eat, and delicious taste. The metals are contained in packaging materials components like tin that can contaminated into the beverages called corrosion, causing contamination [1]. Factors that affect the dissolution of metals from the cans body can occur and influenced by cans material, duration and conditions of storage, acidity of the contacting foodstuff [2,3,4].

Tin is dangerous if it enters into metabolic system in amount where exceeding the threshold. Excessive consumption of tin in the diet can caused irritation on digestive tract that is characterized by vomiting symptoms, diarrhea, fatigue and headache [5].

The maximum limit for tin in canned foods are 200 $mgkg^{-1}$ and 100 $mgkg^{-1}$ for canned beverages, including fruit and vegetable juices and 50 $mgkg^{-1}$ for baby food [6].

Based on the above, the objective of this research is to examine the factors affect of tin released in canned beverages. Research conducted on pH canned beverages, expired date from packaging label, tin assay using atomic absorption spectrophotometer air-acetylene flame at wavelength 286.3 nm.

Experimental

Apparatus

pH meter, hot plate, Whatman No 42, glassware, atomic absorption spectrophotometer (Hitachi Zeeman-2000) with tin hallow cathode lamp. The main charachteristics of equipment for tin determination are: wavelength 286.3 nm, flame: air-acetylene.

Reagents and materials

All reagent were of analitycal reagent grade. 65% Nitric acid (E. Merck), stock standard solution (1000 mgL^{-1}) of tin, deionised water.

Samples

Canned beverages are carbonated beverages with brands A1, A2, A3, beer with brand B1, B2, B3, and juice beverages with brand C1, C2, C3 canned purchased randomly from the market in Medan, North Sumatra, Indonesia. (Each of these beverages brand has two expired time 2014 and 2015). Samples and data nutritional can be seen in Table 1. The research was held in November 2014 in the Faculty of Pharmacy laboratory, University of North Sumatera, Medan, Indonesia.

Expiration

Expired time samples can be seen on the labels of canned beverages and then recorded. Samples and data nutritional can be seen in Table 1.

pH Sample determination

Calibrated meter pH with buffer solution, pipette 10 ml of sample and added into glass beaker, then dipped the electrode into beaker glass [7].

Samples Destruction

Taken as much as 100 ml sample and put into 250 mL erlenmeyer then added 10 ml of 65% nitric acid, evaporated on *hot plate* until it clear. Poured 50 ml into volumetric flask, and ad deionised water up to line mark. Filtered through whatman filter paper No. 42, and first 5 ml filtrates discarded then next filtrates subsequently keep into the bottle [7.8].

Determination of Tin Levels

Solution test from destruction results measured in atomic absorption spectrophotometer air acetylene flame at wavelength 286.3 nm.

Data analysis

Statistical analysis of the data used two-way ANOVA test by *SPSS* with 95% confidence level.

Results and Discussion

pH Effect On Tin Released in Canned Beverages

The results showed that in Table 2 that there is significant correlation of pH effect with tin released in canned beverages. The relationship between pH and tin corrosion associated by volta series, the more to the left of an element in volta series, the more prone to get oxidation that occurs at the anode. The conditions in acidic phase or pH <7, can tin dissolution, since H^+ is reduced which occurs at cathode [10]. The lower pH value, corrosion will increase [3, 9,10, 11, 12, 13].

Expiration Effect Of Tin Released In Canned Beverages

The conclusion is there was an effect from tin released on canned beverages. This is because in carbonated canned beverages, beer, and juice which expires in 2014 and the contact time between canned beverages has been longer than cans in carbonated beverages, beer, and juice which expires in 2015. Tin dissolving into a product affected by the duration of shelf life. Its concentration will increases when cans are stored for a long time period. The longer the shelf life, the greater the contact time of the container by the food so that metal migration will also increase [3, 10,14, 15].

Table 1. Sample and Data Canned Nutrition Beverage, November 2014

Canned Beverages	Man. Date	Exp.Date	Shelf Life (months)	Beverages Duration in Cans (months)	Ingredients
A1	26/12/2012	26/12/2014	24	23	Carbonated water, sugar,
	12/10/2013	12/10/2015	24	13	Aple and orange
A2	24/12/2012	24/12/2014	24	23	Carbonated water,sugar,
	05/09/2013	05/09/2015	24	14	Cola , phospathe acid
A3	26/12/2012	26/12/2014	24	23	Carbonated water,sugar,
	28/09/2013	28/09/2015	24	14	cola, phospathe acid
B1	31/12/2012	31/12/2014	24	23	water, malt,
	24/11/2013	24/11/2015	24	12	cereals, and hops
B2	30/12/2012	30/12/2014	24	23	water, malt, and hops
	18/11/2013	18/11/2015	24	12	
B3	29/12/2012	29/12/2014	24	23	water, malt, sugar,
	15/11/2013	15/11/2015	24	12	hops, and yeast
C1	27/12/2012	27/12/2014	24	23	water, sugar, lychee juice,
	25/10/2013	25/10/2015	24	13	citric acid, malic acid, vit. C
C2	29/12/2012	29/12/2014	24	23	water, sugar, orange juice,
	15/11/2013	15/11/2015	24	12	vitamin C
C3	28/12/2012	28/12/2014	24	23	water, sugar, soursop juice
	30/10/2013	30/10/2015	24	13	vitamin C

Table 2. Effect of pH and Expiration Against Release of Tin In Canned beverages

Canned Beverages	pH	Tin ($mgkg^{-1}$)	
		Expired Date 2014	Expired Date 2015
A1	2,60	5,7676±0,1631	2,8948±0,6425
A2	2,70	5,2412±0,3730	2,8290±0,4491
A3	2,80	4,4737±0,3063	2,8070±0,7206
B1	4,00	3,6623±0,3470	2,6096±0,7678
B2	4,10	3,6184±0,3285	2,5658±0,6815
B3	4,20	3,5965±0,4033	2,5000±0,5648
C1	3,20	4,3421±0,1938	2,7632±0,3874
C2	3,40	3,9473±0,2739	2,7193±0,4259
C3	3,50	3,8158±0,3874	2,7124±0,1704

Conclusion

The lower pH, the release of tin also become higher in canned beverages. The longer period expired, the release of tin also decreased. The results obtained canned beverages still qualify as permitted by Commission Regulation EC No 1881/2006.

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