J. Food and Dairy Sci., Mansoura Univ., Vol. 3 (1): 33 - 44, 2012

INFLUENCE OF ADDITION OF DIFFERENT TYPES OF SUGAR AND LEAVENING AGENTS ON THE ACRYLAMIDE CONTENT IN BISCUITS

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ABSTRACT

The effect of different leavening agents namely ammonium hydrogencarbonate (NH_4HCO_3) sodium hydrogen- carbonate ($NaHCO_3$), baking powder (B.p) with the concentration of 2 and 3g. /100 gm. flour and different types of sugar namely, sucrose, glucose and blackstrap molasses on acrylamide content was studied . Biscuit samples prepared with NH_4HCO_3 2 and 3 g. / 100 g. flour increased the content of acrylamide from 250 to 2390 µg/kg in compare with other added baking agents. The use of baking powder as a leavening agents was a limiting factor for acrylamide content followed by $NaHCO_3$. Results also, indicated that the content of acrylamide was decreased in prepared biscuits formulae by replacing reducing sugar namely glucose with sucrose with adding small amount of baking powder (2 and 3 gm) . All prepared biscuit samples with blackstrap molasses had higher content of acrylamide which were 511 and 2390 µg/kg and exhibited the low score in sensorial properties especially in colour ,taste and crispness in compare with other biscuit formulas under the same baking conditions . All prepared biscuit samples with different types of sugar and baking agents were in the permissible level of acrylamide per day for adults body weight 70 kg according to (FAO/WHO, 2005) which ranged from 21to140 µg/100 g/ day , and Sweden Health Organization which estimated the daily intake(35 µg/ kg for body weight 70 kg /day) except biscuits formula contained 3g $NaHCO_3$ or 3g. NH_4HCO_3 with black strap molasses. So, it could be recommended that use of sucrose and disaccharides in hard biscuits preparation reduced the content of acrylamide , while .addition of 3 gm . of NH_4HCO_3 or 3g $NaHCO_3$ to hard biscuits prepared with blackstrap molasses is not preferable .

Keywords : Hard biscuits, baking agents, reducing sugars, sodium hydrogen carbonate, ammonium hydrogencarbonate, baking powder and safety limit of acrylamide .

INTRODUCTION

Acrylamide is a non-volatile compound which is classified as "potentially carcinogenic to humans". Man can be directly exposed to it by consuming heat-treated foods rich in carbohydrates, such as baked foods, or indirectly through certain packaging materials (Keramat *et al* ., 2011). Acrylamide has been found in a wide variety of fried, baked or roasted foods; it is found in both foods processed by manufacturers and foods that are cooked in the home. Acrylamide is most prevalent in fried potato products such as French fries , potato chips and potato crisps, cereals, crisp breads, biscuits and other bakery wares, and coffee . (FDA, 2004 and Eriksson 2005 ; Törqvist 2005).

The mechanism of formation of acrylamide in food and factors contributing to its formation are now reasonably well understood. Formation of acrylamide commences simultaneously with the Millard reaction with the desired browning coloration of the cooked product, e.g. chips, biscuits, bread, and it is virtually impossible to prevent formation. However, methods adopted

by manufacturing industry worldwide together with research undertaken by food technologists have identified the critical control points CCPs for acrylamide formation, and have led to the identification of some measures to control formation and hence to reduce its levels in food. Levels of asparagine and reducing sugars such as glucose and fructose in the food ingredients, e.g. in potatoes, are key determinants of ultimate levels of acrylamide in the cooked products, and are important points of control. (Anese *et al* ., 2011)

Recently, treatment of raw ingredients with the enzyme asparagines, which breaks down asparagine, has proved to be effective in reducing levels of acrylamide in food. Ammonium-based raising agents are widely used in biscuit manufacture, either individually or as part of a mixed raising system providing browning, crisp and porous crumb. (Sadd and Hamlet ., 2005).

A second large group of products contributing to acrylamide exposure is the cereals and cereal products. It was concluded that there had been only limited success in reducing acrylamide formation in cereals and cereal products in relation to recipe formulation and processing conditions. (Konings *et al*., 2007).

Sugar is one of the key ingredients of cookies and other baked desserts. It contributes to texture, flavor, sweetness and color in cookies and biscuits . The quantity, granulation and type of sugar used influence the quality of biscuits(Smith 1972). High levels of sugar in baked desserts affects flavor, dimensions, color, hardness and surface finish. (CIAA, 2009 and Gallagher *et al*., 2003) .

High sugar concentrations of cookies are not suitable for some special categories of consumers such as diabetes and also made cookie not a safe food because of the high acrylamide content found in cookies with high concentrations of sugars. Food experts usually recommend the reduction of sugar in cookie recipes as a method for production of a low-calorie cookie (Drewnowsk *et al* ., 1998) .Type and concentration of sugars showed a strong influence on acrylamide formation in cookies, but sucrose was less efficient than glucose on the yield of acrylamide, expectedly. Sucrose is the main sugar utilized in the biscuit industry. (Anese *et al* ., 2011).

Leavening or baking agents is a substances used in dough and batters that cause a foaming action which lightens and softens the finished product. The leavening agent incorporates gas bubbles into the dough (Simmons and Tolford , 1984 and Sadd *et al* ., 2008).

Ammonium hydrogen carbonate is significant encouragement of acrylamide formation in bakery products. Raising agents ammonium bicarbonate has been found to increase the potential for acrylamide formation due to the ammonium component. Ammonium appears to be an important factor in acrylamide formation, such as in sweetened bakery products. Replacing ammonium bicarbonate with other raising agents e.g. sodium hydrogen carbonate can significantly lower the levels of acrylamide formed in many cereal products. The amounts of sodium used in raising agents are unlikely to contribute significantly to dietary sodium intake. The flavour implications also need to be carefully considered for some products. (Sadd *et al.,* 2008 and Konings *et al*., 2007).

This work aimed to study the effect of addition of different types of leavening agents sugar substitutions (glucose and blackstrap molasses) on the acrylamide content of hard biscuit in compare with standard biscuit formula also calculating the healthy safe limit of acrylamide for children and adults according to (FAO/WHO , 2005).

MATERIALS AND METHODS

Materials :

Wheat flour (*Triticum aestivum)* 72% extraction imported American wheat flour was obtained from Metro market, El- Mansoura, Egypt .

Other ingredients: sugars (sucrose, glucose and blackstrap molasses), salt, baking powder (sodium hydrogen carbonate+tartaric acid + cornstarch + calcium phosphate) and vanillin were obtained from Metro market, El- Mansoura, Egypt . Leavening agents namely ammonium hydrogencarbonate (NH_4HCO_3) and sodium hydrogen carbonate ($NaHCO_3$) were purchased from El-Gomhoria Company for chemicals, El-Mansoura, Egypt. and vegetable shortening was obtained from Misr Oil and Soap Company , El- Mansoura, Egypt.

Preparation of biscuits:

All biscuit samples were prepared included 100 g. of wheat flour 72 % extraction with baking powder 3g., water 26.1 ml, shortening 20g, salt 1g. and sugar 40 g. , according to the method described by Abdel-Magied (1991). The biscuits were prepared using glucose and blackstrap molasses substituted of sucrose and also baking powder of , all prepared biscuits samples were substituted with sodium hydrogencarbonate($NaHCO_3$) or ammonium hydrogen Carbonate (NH_4HCO_3 (with 2 and 3 gm) as shown in Table (1).

Table (1): Biscuit formulas prepared from different types of sugar and baking agents.

Leavening agents / Type of sugar	Bp*		$NaHCO_3$		NH_4CO_3	
	2 g.	3g.	2 g.	3g.	2 g.	3g.
1-Sucrose	-	-	-	-	-	-
2-Sucrose	-	√	-	-	-	-
3-Sucrose	-	-	-	-	-	√
4-Sucrose	-	-	-	√	-	-
5-Sucrose	√	-	-	-	-	-
6-Sucrose	-	-	√	-	-	-
7-Sucrose	-	-	-	-	√	-
8-Glucose	-	√	-	-	-	-
9-Glucose	-	-	-	-	-	√
10-Glucose	-	-	-	√	-	-
11-Glucose	√	-	-	-	-	-
12-Glucose	-	-	√	-	-	-
13-Glucose	-	-	-	-	√	-
14-blackstap Molasses	-	√	-	-	-	-
15 blackstrap -Molasses	-	-	-	-	-	√
16- blackstrap Molasses	-	-	-	√	-	-
17- blackstrap Molasses	√	-	-	-	-	-
18- blackstrap Molasses	-	-	√	-	-	-
19- blackstrap Molasses	-	-	-	-	√	-

* B.p . = Baking powder

While there was a formula prepared without any addition of leavening agents . All biscuit formulas were baked at 225 C for 15 min., then cooled and packaged in polyethylene bags for further investigations.

Methods :

Reducing sugar% : were determined according to (Ranganna 1977) at Chemistry Dept., Faculty of Agriculture , Mansoura university, Egypt.

Acrylamide Content Extraction and analysis of acrylamide: was carried out in Central Laboratory of Higher Institute for Public Health, Alex University, Using Shimadzu HPLC CRA Chromatography PAC, mobile phase 0.1 % acetic acid: methanol 0.5%, wave length: 230nm, Injection volume 30 µl , Colum rate 1ml/ m.

pH : was determined according to A.O.A.C (2000) using pH meter model Jenway, 3505 .U.K.

Sensory Evaluation: The sensory evaluation of baked biscuit was estimated by ten panelists for taste, odor ,colour, crispness and overall acceptability as the method described by Gerczyca and Zabic (1979). At home Economics Dept. , faculty of Specific Education , Mansoura university .

Statistical Analysis:

Values represented are the means and standard error, significance was used at $p<0.05$,(ANOVA) was done using SPSS 17 program for windows. According to SPSS, (2007).

RESULTS AND DISCUSSIONS

A- Influence of addition different leavening agents on acrylamide content :

1- Ammonium hydrogen carbonate (NH_4HCO_3):

The baking agent is known to effect strongly on the acrylamide content (Amrien *et al* ., 2004). Data in table (2) showed that biscuits prepared with different leavening agents namely ammonium hydrogen carbonate NH_4HCO_3 , sodium hydrogen carbonate($NaHCO_3$)and Baking powder (B.P) at the concentration of 2 and 3 gm./100 g flour 72 % extract. and baked at 225 °C for 15 min. were varied in the content of acrylamide .

Different amount of ammonium hydrogen carbonate NH_4HCO_3 were added to different biscuit formulas with the addition of 2 and 3 g. / 100 gm flour . Results were tabulated in Tables 2 and 3, the amount of NH_4HCO_3 had a clear effect on the acrylamide formation in biscuit samples. Biscuit samples (control 1) prepared without adding baking agent almost no acrylamide was formed about (12µg/kg.) and the product was unsatisfied for taste , odor, colour and crispness because it lacked in browning and leavening agents . This results are in accordance with (Amrien *et al.*, 2005) who stated that the formation of acrylamide nearly negligible (10µg/kg.) with biscuit prepared without baking agents.

Results also indicated that the biscuit formulas contained 2g. NH_4HCO_3decreased the content of acrylamide up to 740 µg/kg in compare with the other biscuit formulas contained 3 g. of NH_4HCO_3 was 2390 µg/kg .

Also these biscuit formulas prepared with addition of 2 and 3 g. NH_4HCO_3 were bright in color ,taste was favorable and odour were

unacceptable , whereas the addition of 3g. NH_4HCO_3 increased the content of acrylamide and enhanced the browning colour .Also, it could be observed that NH_4HCO_3 promotes the formation of acrylamide in biscuits (Amrien 2005 *et al* ., and Biedermann *et al* ., 2002).

Results in Table (2) , indicated that the amount of NH_4HCO_3 which added to biscuit samples effect on the pH values , the increase in NH_4HCO_3 due to the increase in pH led to increases in colour darkness and related to high amount of acrylamide .

Table (2) : Acrylamide content (µg/kg) , pH values and reducing sugar % for biscuit formulas.

Biscuits formula	Acrylamide content µg/kg	Biscuit Dough pH	reducing sugar %
1-sucrose + 3g. Bp* (control 2)**	280	7.3	0.9
2- Sucrose + 3g. $NaHCO_3$	420	8.2	1.2
3- sucrose + 3g.NH_4CO_3	480	8.1	1.6
4- Glucose + 3g. Bp	300	7.9	1.5
5- Glucose +3g. $NaHCO_3$	440	8.1	1.6
6- Glucose +3g. NH_4CO_3	485	8.0	1.8
7- Molasses +3g. Bp	1260	7.9	2.1
8- Molasses + 3g. $NaHCO_3$	2290	7.8	2.2
9- Molasses + 3g. NH_4CO_3	2390	7.9	2.3
10- Sucrose + 2g. Bp	127	8.1	0.7
11- Sucrose + 2g. $NaHCO_3$	186	8.3	0.8
12- Sucrose + 2g. NH_4CO_3	250	8.1	1.1
13- Glucose + 2g. Bp	280	7.9	1.2
14- Glucose + 2g. $NaHCO_3$	330	8.1	1.3
15- Glucose + 2g. NH_4CO_3	410	8.2	1.5
16- Molasses +2g. Bp	511	7.8	1.3
17- Molasses + 2g. $NaHCO_3$	650	7.9	1.4
18- Molasses + 2g. NH_4CO_3	740	7.8	1.7

*** B.p. = Baking Powder** **control 2 ** = standard biscuit**

From the same results in Table 2 it could be observed that the temperature during baking process was 225 C also effect on the formation of acrylamide. (Amrien *et al* ., 2006). So, the promoting effect of NH_4HCO_3 on the acrylamide formation could be explained by the reaction of asparagine with reactive carbonyls. Glyoxal and methyl –glycoxal are formed from reducing sugar in Millard reactions models and many other products namely α- carbonyls and α- hydroxyl carbonyls are formed from reducing sugar in the Millard reactions and these reactions may be responsible for the high content in acrylamide in prepared biscuit with the 3 g. of NH_4HCO_3 . (Amrien *et al* ., 2005 and Hollnagel and Kroh 1998)

2- Sodium hydrogen carbonate($NaHCO_3$)and Baking Powder (B.p) :

Results in Table (2), indicated that the addition of $NaHCO_3$ at 2 and 3 g. /100 gm. flour to biscuits formulas as another leavening agents could reduced the content of acrylamide in biscuits in compare with formulas

prepared with NH_4HCO_3 , and addition of 2 gm of $NaHCO_3$ led to an acceptable products with high score in taste, odour, colour and crispness (Table 3).

Table (3) : Sensory evaluation of prepared biscuit samples after baking

characteristics biscuit samples	Taste	Colour	crispness	odour	Overall acceptability
1-sucrose+3g. Bp* (control)	9.54	9..80	9.81	9.71	9.89
2- Sucrose + 3g. $NaHCO_3$	9.41 ± 0.18	9.40 ±0.32	9.30 ±0.13	9.40 ±0.15	9.46±0.24
3- sucrose + 3g.NH_4CO_3	8.52 ±0.13	8.50 ±0.19	8.43 ±0.14	7.34 ±0.16	8.48 ±0.24
4- Glucose + 3g. Bp	8.83 ±0.14	8.63 ±0.04	8.70 ±0.14	8.11 ±0.12	8.21 ±0.02
5- Glucose +3g. $NaHCO_3$	8.80 ±0.12	8.54 ±0.01	8.75 ±0.17	9.57 ±0.14	9.61 ±0.04
6- Glucose +3g. NH_4CO_3	7.51 ± 0.19	7.92 ±0.03	8.50 ±0.43	7.03 ±0.05	8.52 ±0.04
7- Molasses +3g. Bp	8.10 ±0.12	8.01 ± 0.02	8.00 ±0.12	8.00 ±012	8.01 ± 0.15
8- Molasses + 3g. $NaHCO_3$	8.78 ±0.13	7.50 ±0.04	8.32 ±0.19	8.43 ±0,12	9.02 ±0.32
9- Molasses + 3g. NH_4CO_3	8.50 ±0.12	7.40 ±0.24	8.54 ±0.18	7.54 ±0.01	8.01 ±0.14
10- Sucrose + 2g. Bp*	9. 50 ±0.04	9.65 ±018	9.45 ±0.06	9.33 ±0.02	9.43 ±0.23
11- Sucrose + 2g. $NaHCO_3$	9.30 ±0.05	9.33 ±0.13	9.43 ±0.05	9.34 ±0.10	9.60 ±0.51
12- Sucrose + 2g. NH_4CO_3	8.20 ±0..01	8.14 ±0.05	8.11 ±0.07	7.50 ±0.16	8.33 ±0.03
13- Glucose + 2g. Bp*	8.61 ± 0.18	8.89 ±0.01	8.11 ±0.19	8.00 ±0.03	8.77 ±0.12
14- Glucose + 2g. $NaHCO_3$	8.22 ±0.13	8.07 ±0.02	8.56 ±0.15	8.33 ±0.16	8.01 ±0.13
15- Glucose + 2g. NH_4CO_3	7.10 ±0.12	9.04 ±0.08	9.21 ±0.14	7.24 ±0.21	8.07 ±0.14
16- Molasses +2g. Bp	8.71 ±0.21	8.00 ±0.18	8.55 ±0.24	8.07 ±0.04	8.03 ±0.34
17-Molasses + 2g. $NaHCO_3$	8.71* *±0.21	8.00* *±0.18	8.55**±0.24	8.07**±0.04	9.03* *±0.34
18- Molasses + 2g. NH_4CO_3	8.71* *±0.21	8.00* *±0.18	8.55**±0.24	7.07* ±0.01	8.03* *±0.34

*** B.p. = Baking Powder**

****Significant differences at p < 0.05 . Means of triplicates samples results ± SD**

Also, the values of pH in prepared biscuits with $NaHCO_3$ with 2 and 3 gm. were ranged from (7.8 to 8.2). These alkaline pH values were suitable to reduce the content of acrylamide , and NaHCO3 allows to be used in the biscuit preparation with a substantially less acrylamide, which were acceptable in both of browning colour and sensory properties.

Data in Table 2 revealed that , biscuit prepared with baking powder B.p led to the lowest content of acrylamide ranged from 127 and 280 µg/kg in prepared biscuits formula with 2 and 3 g baking powder respectively , however browning colour was also less pronounced for all biscuits formulas prepared with leavening agents at 2 and 3 g. in compare with other baking agents. The addition of baking powder which contained tartaric acid as organic acid almost devoid of acrylamide formation explained by pH reduction and reduced the content of acrylamide . (Graf *et al* ., 2006; Vass *et al* ., 2004 and Weisshaar , 2004) .

From abovementioned results in (Table 2) combination of organic acid with $NaHCO_3$ as a leavening agents is a suitable to reduce the content of acrylamide and no negative effect on sensory properties were observed , also some authors reported that addition of tartaric acid to biscuit and crackers decrease the amount of acrylamide with the increasing amount of acid thereby reducing the pH by 30 % , which due to hydrolysis of the carboxamide group leading to aspartic acid at lower pH , resulted in moderate

Milliard reactions accompanied by lower acrylamide formation . (Claus *et al* ., 2008 ;Amrien *et al* ., 2006)

B-Influence of addition of different types of sugar on acrylamide content :

The influence of addition of different types of sugar namely, sucrose, glucose and blackstrap molasses to biscuits samples were studied and the results were tabulated in Table (2).

Data revealed that the types of sugar at different concentrations which added to the prepared biscuits dough were varied in the content of acrylamide and reducing sugar % . Biscuits prepared by addition of sucrose led to the lowest content of acrylamide (127and 168 µg/kg.) and 0.7 and 0.8% reducing sugar in samples prepared with the addition of sucrose + 2g. baking powder or sucrose + $NaHCO_3$ in compare with other biscuit formulas. This may be due to addition of sucrose to the formulas was less effective on the increasing amount of acrylamide than glucose and blackstrap molasses , this could be due to that the hydrolysis of
sucrose might be very limited under baking conditions (225°C for 15 min.) . These results were almost in accordance with those given by (Graf *et al* ., 2006 ; Vass *et al* ., 2004 Amrien *et al* ., 2004 and Yaylayan *et al* ., 2003) .

Sugars also, play a crucial role in acrylamide formation and content , it was stated by (Vass *et al* ., 2004) that replacing invert sugar with sucrose in wheat crackers reduced acrylamide by 60 % . similar effects were also observed by (Amrien *et al* ., 2004) , who explained that there were a lack of reactive carbonyl compounds namely fructose and glucose which led a strong decrease in Millard reactions in general , therefore the product was insufficiently browned and had to be colored . Some authors (Keramat *et al* ., 2011 ; Surdyk *et al* ., 2004 and Noti *et al* ., 2003) reported that reducing sugar needed to form acrylamide from asparagine , and sugars seems to be the most important ingredient in the dough formula for the formation of acrylamide because the free asparagine is relatively low in wheat flour, and the mechanism of enhancing effect for sugar due to glyoxal resulted from thermal decomposition formed 350 times more acrylamide in the presence of asparagine than did fructose only. The reaction pathway from hexoses to glyoxal and finally to acrylamide is as follows: ammonium is released from NH_4HCO_3 and reacts readily with carbonyl group of glucose and fructose due to nuclophlic character, the amines formed allow generation of glucosones and , further more hydroxyal, erythose and glyoxal by retro-aldol reaction , which are more reactive with asparagine in acrylamide formation.

Results in Table (2) indicated also that biscuit formulas prepared with the addition of glucose and blackstrap molasses have low value of pH in compare with the other prepared biscuit with sucrose, these low values of pH increased the amount of acrylamide by 8.5 times in compare with control biscuits samples (standard biscuit control) under the same baking conditions.

Data in Table (3) showed that all biscuit formulas prepared with sucrose exhibited the highest score in odour, taste and crispness and are typically

bright in colour in compare with the other prepared biscuits formulas with addition of glucose and molasses. Additionally, the addition of molasses to biscuits formulas increased the browning and dark colour and reduced the score of crispness beside improvement the taste. These data were in accordance with those t given by (Sadd and Hamlet 2005) .

Our obtained results were also in accordance with Amrien *et al* ., 2004 who demonstrated that NH_4HCO_3 did not increase the acrylamide when sucrose was used instead of inverted sugar.

Finally it could be observed that the kinetics of acrylamide is completely different between the biscuit formulas containing sucrose (with low initial rate of formation) and those prepared with glucose and molasses which increased rapidly the formation of acrylamide . Our obtained results were in accordance with (Summa *et al* ., 2006). Who reported that acrylamide concentration increases during baking process with an increase of different additives such as sucrose, inverted sugars and asparagine.

C- Healthy safe limit and the daily intake from acrylamide in biscuit formulas on consumption of 100 gm from the biscuits .

Healthy safety quality of biscuit formulas were calculated for acrylamide content and the possible daily intake of these compounds were tabulated in Table (4) .

Table (4) : Healthy safe limit and the daily intake from acrylamide off all biscuits samples under investigation.

Biscuits formula	Acrylamide content (µg/100 g.) in biscuit formulas with maximum permissible level(FAO/WHO, 2005).* Acrylamide content (µg /30 g.) in biscuit formulas with maximum permissible level (FDA ,2004).**		
	Acrylamide content	Status*	Status**
1-sucrose + 3g. Bp* (control)	28	-	+
2- Sucrose + 3g. $NaHCO_3$	42	-	+
3- sucrose + 3g.NH_4CO_3	48	-	+
4- Glucose + 3g. Bp	30	-	+
5- Glucose +3g. $NaHCO_3$	44	-	+
6- Glucose +3g. NH_4CO_3	48.5	-	+
7- Molasses +3g. Bp	126	-	+
8- Molasses + 3g. $NaHCO_3$	229	+	+
9- Molasses + 3g. NH_4CO_3	239	+	+
10- Sucrose + 2g. Bp	12.7	-	+
11- Sucrose + 2g. $NaHCO_3$	16.8	-	+
12- Sucrose + 2g. NH_4CO_3	25	-	+
13- Glucose + 2g. Bp	28	-	+
14- Glucose + 2g. $NaHCO_3$	33	-	+
15- Glucose + 2g. NH_4CO_3	41	-	+
16- Molasses +2g. Bp	51.1	-	+
17- Molasses + 2g. $NaHCO_3$	65	-	+
18- Molasses + 2g. NH_4CO_3	74	-	+

- ***maximum permissible level FAO/WHO,(2005) at range of (21-140 µg/100 g)for the general population (body weight 70kg).**
- ** **permissible level FDA,(2004) 1.26 µg /30 g)for children of age(2 -5) years.**

(+) : more than the permissible limit (-) : less than the permissible level

Bp * : Baking Powder

When the maximum level of acrylamide base on consumption 100 gm of biscuits should be baked at 225 C for 15 min and prepared by the addition of sucrose to biscuit dough formulas with 2 and 3g. were better in reducing the acrylamide content in compare with glucose and blackstrap molasses with the following leavening agents: baking powder, $NaHCO_3$ and NH_4HCO_3.

So, these additives namely leavening agents avoid the formation of acrylamide content , and addition of 2and 3 g/100gm flour from baking powder , NaHCO3 and NH_4HCO_3 caused decrement of acrylamide formation . Values of acrylamide were less than permissible level of acrylamide .(FAO / WHO ,2005) and also the values were in the average of dietary intake estimated up to 35 µg/kg body weight 70 kg / per day according to Sweden and World health organization except biscuits formula contained 3g $NaHCO_3$ and NH_4HCO_3 with black strap molasses .

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تاثيراضافة انواع مختلفة من السكر والمواد الرافعة علي محتوي البسكويت من الاكريلاميد

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تم دراسة تاثير اضلفة انواع مختلفة من السكر(السكروز و الجلوكوز و العسل الاسود) والمواد الرافعة (كربونات الامونيوم و كربونات الصوديوم والبيكنج بودر) بنسبة ٢ و٣ جرام / ١٠٠ جرام دقيق قمح استخلاص ٧٢% علي محتوي البسكويت الصلب من الاكريلاميد . اظهرت النتائج ان عينات البسكويت المصنعة باضافة ٢ و٣ جرام من كربونات الامونيوم / ١٠٠ جرام دقيق ادت الي زيادة كمية الاكريلاميد من ٢٥٠ الي ٢٣٩٠ ميكروجرام / كجم مقارنة بعينات البسكويت المصنعة باضافة المواد الرافعة الاخري . يعتبر استخدام البيكنج بودر من العوامل المحددة لتكوين الاكريلاميد يليه كربونات الصوديوم و اظهرت النتائج ايضا انه يمكن تقليل محتوي الاكريلاميد في عينات البسكويت المصنع باستبدال السكرات المختزلة مثل الجلوكوز بالسكروز مع كميات قليلة من البيكنج بودر(٢و ٣ جرام) .

اظهرت النتائج ان كل عينات البسكويت المصنع باستخدام العسل الاسود سجلت اعلي قيم في محتواها من الاكريلاميد وكانت ٥١١و ٢٣٩٠ ميكروجرام/ كجم كما اظهرت انخفاضا ملحوظا في الخواص الحسية وخاصة اللون والطعم والقرمشة مقارنة بعينات البسكويت الاخري المصنعة تحت نفس ظروف الخبيز .

اظهرت النتائج ان كل عينات البسكويت المصنع باستخدام الانواع المختلفة من السكر والمواد الرافعة كان محتواها من الاكريلاميد في الحدود الصحية الامنة المسموح بها (٢١-١٤٠ ميكرو جرام / كجم/ اليوم) للفرد وزن ٧٠ كجم تبعا FAO/WHO 2005 ومنظمة الصحة السويدية (٣٥ ميكروجرام / كجم / اليوم – للفرد وزن ٧٠ كجم) فيما عدا خلطات البسكويت المحتوية علي ٣جرام كربونات الامونيوم او ٣ جرام كربونات الصوديوم مع العسل الاسود .

وتوصي الدراسة باستخدام السكروز والسكريات الثنائية في صناعة البسكويت لتقليل تكوين الاكريلاميد وعدم استخدام كربونات الامونيوم او كربونات الصوديوم بنسبة ٣جرام مع عجينة البسكويت الصلب المحتوية علي العسل الاسود.

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