PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 8 (7): 1074-1077, 2009
ISSN 1680-5194

The Effect of Lecithin-A Non-Absorbing Emulsifying Agent on Cookie Production

M.Z. Hoque, K.M. Hossain and F. Akter
Biotechnology and Genetic Engineering Discipline, Khulna University, Khulna-9208, Bangladesh

Abstract: Emulsifying agents have an effect on cookies and the finished product partially, depending on the system and the type of emulsifier used. Lecithin's molecular structure makes it an effective emulsifier for the interaction of water and oil. Phospholipids, the major component of lecithin, are partly hydrophilic (attracted to water) and partly hydrophobic (repelled from water). Fat is particularly important in the texture of a low-moisture cookie. The present study has desirable significance which relates to practical issues like cookies dough emulsions, optimization of manufacturing, quality control and effects on prolonging shelf life prediction. The investigation revealed that the method applied was very suitable for determining the effects of lecithin on cookie production. According to the method 0.27, 0.21, 0.19 and 0.16% lecithin were mixed based on dough weight by using a Horizontal-Z-Drum mixture machine in four different cookie samples (S-1, S-2, S-3 and S-4 respectively) and the moisture absorption rate of four samples were analyzed by using Scaltec auto moisture analyzer. The moisture absorption rate at 30 minutes for S-1, S-2, S-3 and S-4 were 2.10, 3.11, 3.19 and 3.23% respectively. For S-1, 0.27% lecithin shown minimal moisture absorption at 30 min. Therefore, it is clear that increase of emulsifying agent decreases the rate of moisture absorption in cookies and lecithin might have a great effect on preservation of cookies. The study recommends that further enthusiastic investigation may continue for the prediction of optimum dose of lecithin for maximum shelf-life of cookies.

Key words: Emulsifying agents, lecithin, cookie, shelf-life

INTRODUCTION

Changing lifestyles have resulted in a greater demand for food that will stay fresh and safe longer. As more people move from farms to cities, there is an increasing need for foods that can be produced in great quantities, shipped over great distances and stored for long periods of time (Weese, 2005).

Tough, dry, stale, leathery, tasteless, these are words that describe baked goods without emulsifiers. The processing, distribution and storage of these products necessitates the use of food additives to maintain the quality and freshness that consumers expect (Brandt, 1996).

Emulsifiers, a subset of surfactants, are commonly used in many food products. An emulsion is a dispersion of small droplets of one immiscible liquid within another. Emulsifiers keep the droplets from coalescing. Although these food additives may offer some degree of emulsification, they perform more important functions in baked goods, such as starch complexing, protein strengthening and aeration (Hegenbart, 1996).

The bakery industry is the largest user of food emulsifiers, according to industry sources. Recent figures indicate that about 400 million pounds of emulsifiers were used by the food industry; approximately two decades ago about half as much was used. The bakery industry accounts for 50% of the total food emulsifier market and it is estimated that the growth of emulsifiers used in the baking industry will be about 3% per year (Nairn, 1993).

Food emulsifiers have long been a vital ingredient in processed foods containing fats and oils, while more recently they've also been playing an important role in numerous low and no-fat products. The reasons for this expansion are that, in addition to stabilizing water and oil mixtures, emulsifiers perform numerous other functions. These include functioning as aerating/foaming agents, defoaming agents, crystallization promoters, viscosity modifiers, dispersants, crystallization inhibitors, lubricants and agglomerating agents (Wilkes, 1992).

Still other emulsifying ingredients occur naturally. An example is lecithin derived from soybean oil. It is lecithin's ability to simultaneously interact with both oil and water that makes it such an effective and stable emulsifier. When introduced into a system, an emulsifier acts to help maintain a stable emulsion between two unmixable liquids. The emulsifier decreases the surface tension between the two liquids and allows them to mix and form a stable, heterogeneous dispersion (Matz, 1996a,b,c,d,e,f).

Fat is added to cookie dough for its effect on both the finished product and the process. Fat acts as a lubricant. It keeps the dough from sticking to the feeding and forming equipment. It facilitates mixing by lubricating the other ingredients. And it helps the cookies release from the baking surface without sticking. Fat helps control the texture of the finished product, its spread and its appearance. In most cookies containing fat, a plastic

(solid or semi-solid) shortening is first combined with the sugar in a creaming stage. This helps to entrap air and contributes to the structure or grain of the finished product. It also influences the density of the dough. During creaming, the shortening coats the individual sugar particles. Fat is particularly important in the texture of a low-moisture cookie (Kuntz, 1996).

In Bangladesh, the productions of cookies are more dramatic. All these items do have some problems during preservation. Therefore, the researchers did advocate for assessing the preservation of cookies. Considering the above facts, the present study was undertaken to study the effects of lecithin - a non-absorbing emulsifying agent on cookie production.

MATERIALS AND METHODS

Steps for cookie making

Formulation of dough: Dough formulation was done in two stages. At first hard type flour, sugar, yeast and enzyme were mixed with soft water to make dough for fermentation. After fermentation other ingredients for cookie were added to formulate 365 kg final dough sample.

Formulation of dough for fermentation: Hard type wheat flour, sugar, yeast and enzyme were taken in a large size vessel and mixed with enough soft water. The mixture was left 3 h for fermentation. After fermentation the dough became soft and porous with less viscosity.

Formulation of final dough sample: Fermented dough and other ingredients (Table 1) were mixed with enough soft water to make final dough sample of cookie. Water is a common ingredient that varies in amount depending on the environment.

Table 1: Formulations of dough for different cookie samples

Sr. No.	Ingredients	S-1 Quantity (kg)	S-2 Quantity (kg)	S-3 Quantity (kg)	S-4 Quantity (kg)
1.	Wheat flour	216	200	210	215
2.	Sugar powder	70	82	74	74
3.	Oil	60	60	60	60
4.	Starch	6	8	8	10
5.	Soya flour	2	-	-	-
6.	Salt	2.2	2	2	2.8
7.	Leavening agents	6	6.2	5.3	2.6
8.	Lecithin	1	0.8	0.7	0.6
9.	Sodium Acid Pyrophosphate	0.5	-	-	-
10.	Monosodium Glutamate	0.03	-	-	-
11.	Malt extract	0.37	-	-	-
12.	Flavouring agents	0.9	-	-	-
13.	Milk powder		6	5	-
Total	365	365	365	365	-

Processing techniques

Mixing: Horizontal mixture machine were used to mix the ingredients for the formulation of final dough sample of cookie. A horizontal mixture machine contain a U-shaped mixing bowl, is mounted on a rigid frame over a compartment enclosing the drive motor and its transmission. A single horizontal agitator shaft passes through the bowl from side to side and is turned by a sprocket and chain drive leading from the transmission. Mixture arms are affixed to two spiders mounted inside the bowl agitator shaft. The mixture is always nearly fitted with a two-speed motor to permit high and low speed mixing. Timers, or more sophisticated controls, are always include in the circuits and there is also a provision for jogging, or giving the agitators a partial turn, to assist in throwing the dough out of the chamber during the discharge operation. In the mixing process two-staged method was used which include the following stages:

Stage-1: In this stage, mixing was done of all the ingredients together, including water, fermented dough, sugar, fat, emulsifying agents and other minor components, except the leavening agents. The mixing time was 4-10 min at lows peed and at 40°C until the solid material was dissolved and creamed up.

Stage-2: In this stage the flour and leavening agents were added. The mixing process continued until desired consistency of dough was reached.

Making of dough sheet: In this stage processing, dough was passed through shitting roller to reduce in thickness and shaped into a sheet of relatively uniform thickness, for the purpose of cutting from the sheet many pieces of constant linear dimensions and weight and preparing the sheet further processing. Sheeting is also useful for combining strips of dough from end to end, so that a continuous wed is presented to the next processing equipment. Sheeting rollers consist of a pair of metal cylinders either horizontally or vertically aligned, with provisions made for adjusting separation ("gap") between them. Their axles are always parallel. A conveyor belt brings the dough piece into the nip of the rollers at a constant, usually adjustable, rate and take-away conveyor removes the sheeted dough at a faster rate consistent with the amount *of* extension resulting from the rollers' stretching action. Dusting flour is often applied just before the dough enters the gap.

Laminating of dough: In this stage of processing, dough preferably under mixed but of good stability (resistant to breakdown when over mixed) each sheeted out to give a fairly thick layer. Hydro- pneumatic laminator was used in the lamination process. The laminator accepts the sheeted dough, cut it into rectangles of appropriate dimensions and deposit in an overlapping stack on a belt moving transversely to the depositing conveyer. The lamination process provides a uniform mixture of ingredients in the dough sheet.

Rotary cutting and stamping: Rotary cutting used for the cookie production consist of two synchronized cutter cylinders. The first roller impress the top design on the dough sheet and punctures the sheet with docking pins, while the second carries the ridges that cut the cookie out line. The embossing roller compresses the dough to the proper thickness, thus improving weight and dimensional control and makes the dough piece adhere to the conveyer belt so that it is less likely to get stuck the cutter. Scrap is lifted off the belt in the usual way, leaving the dough pieces to be transferred to the oven band.

Baking: PLC-oven (programmed and logical controlled oven) was used for the baking of the cookie. PLC-oven is consisting of four regions. The temperature during baking, in first, second, third and fourth zone were 311°C, 297°C, 297°C and 263°C respectively. Total baking time was 4.5 min.

Cooling: After the baking the hot cookies were passed through cooler for the cooling of the products. In this stage cookies became hard leaving excess moisture.

Packaging: Finally the biscuits are packaged by different packaging materials (e.g. polythene film, paper board cartons). Sealing machine is used during packaging.

Storage: Cookies are stored in air-conditioned and low moisture (4-5%) room up to one year.

Moisture analysis (samples S-1, S-2, S-3 and S-4): Moisture is the major factor for cookies shelf life. The higher content of moisture absorption lowers of its shelf life. Moisture contents of cookie at various times were determined directly by using moisture analyzer (Scaltec, SMOI, Germany). The analysis was carried out in at 105°C for 5 min by using auto moisture detection equipment.

Procedure: Results were shown in Table 2.

- Blending machine was used to blend cookies to form fine powder.
- Temperature and time were adjusted in the moisture analyzer.
- Powder samples were spreader on a paper for the absorption of moisture from the air.
- Three gm powder was taken on an oil paper and placed inside machine.
- Moisture content was noted after 5 min.
- Moisture content was measured taking sample from paper after every 5 min for 45 min.

RESULTS AND DISCUSSION

The present study was performed to observe the effects of emulsifier especially lecithin on fatty compounds in the preservation of cookies and moisture absorption

Table 2: Moisture absorption rate of different cookie

Sr. No.	Weight (gm)	Time (min)	Moisture Absorption Rate (%) S-1	S-2	S-3	S-4
1.	3.00	0	1.55	2.45	2.31	2.89
2.	3.00	5	1.68	2.66	2.49	2.92
3.	3.00	10	1.82	2.70	2.67	2.99
4.	3.00	15	1.90	2.91	2.84	3.06
5.	3.00	20	1.99	2.96	2.94	3.10
6.	3.00	25	2.01	3.05	2.98	3.19
7.	3.00	30	2.10	3.11	3.19	3.23
8.	3.00	35	2.15	3.19	3.61	3.28
9.	3.00	40	2.18	3.23	3.77	3.32
10.	3.00	45	2.27	3.32	4.13	3.39

rate has shown in Table 2. During 30 min, moisture absorption rate of samples S-1, S-2, S-3 and S-4 were 2.10, 3.11, 3.19 and 3.23% respectively and percentages of lecithin were S-1: 0.27%, S-2: 0.21%, S-3: 0.19% and S-4: 0.16%. Fig. 8 shows that S-1 absorbs lowest moisture where lecithin was 0.27% and moisture absorption gradually increases with the decreasing of lecithin percentage. Therefore, it is obvious from the Fig. 6 that shelf-life of S-1 will be maximum.

Brandt (1996) observed that emulsifiers help retard staling in baked goods, thereby prolonging the shelf life and also stated that it is cheaper to increase the shelf life of baked goods by adding emulsifiers and shipping them farther, rather than rebuilding old plants. The present study also shows the similar effect of lecithin to increase cookies self life through minimal moisture absorption.

Farid (1997a,b) observed lecithin is used extensively in cookie and cracker formulas at level of 0.25-1% of dough weight and have found widespread applicability as release agents in cookie baking due to their spray ability, surface spread ability, handleablity and improved release from rotary die faces. The present investigation has also found the similar effects of lecithin on cookies. Besides lecithin other ingredients such as leavening agents (e.g. ammonium bicarbonate, sodium bicarbonate), starch may have partial effect on cookie preservation. Preservation also depends on environmental factors and storing condition.

In the Fig. 1 moisture absorption for 30 min at 105°C for different cookie samples were observed. The mass level of absorption in the same condition these are 3.23, 3.19, 3.11 and 2.1% respectively, for sample S-4, S-3, S-2 and S-1. 3.23% is the most highest pick of moisture and 2.1% is lower absorption. Because of their special molecular structure and their lipophilic and hydrophilic functional groups, they are able to lower the interfacial tension between components and are known to affect a number of properties of the cookies dough, e.g., rheology, the sensitivity to moisture and temperature and tempering behavior.

Conclusion: Tough, dry, stale, leathery, tasteless, these are words that describe baked goods without

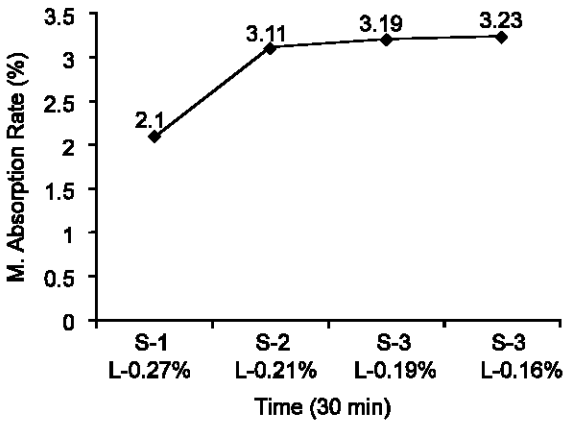

Fig. 1: The moisture absorption rate of samples

emulsifiers. The processing, distribution and storage of these products necessitates the use of food additives to maintain the quality and freshness that consumers expect. Emulsifiers, a subset of surfactants, are commonly used in many food products. Emulsifiers are incorporated into cookie formulas to improve dough handling and the product's overall quality and they result in significant improvements in machinability, dough conditioning/strengthening and shelf life extension and crumb softening.

The investigations suggests that emulsifier especially lecithin would have a pronounced influence on shelf-life of cookies, depending on the types of emulsifier and its concentration, which does vary in a technological relevant range. Because of their special molecular structure and their lipophilic and hydrophilic functional groups, they are able to lower the interfacial tension between components and are known to affect a number of properties of the cookies dough, e.g., rheology, the sensitivity to moisture and temperature and tempering behavior.

REFERENCES

Brandt, L., 1996. Contributing Editor, Emulsifiers in Baked Goods. Food Product Design, Virgo Publishing, USA.

Farid, H., 1997a. Science of Cookies and Crackers Production. 1st Edn, CBS Publishers, New Delhi, India, pp: 253-255.

Farid, H., 1997b. Science of Cookies and Crackers Production. 1st Edn, CBS Publishers, New Delhi, India, pp: 258-260.

Hegenbart, S., 1996. Emulsifier Applications. Food Product Design, Virgo Publishing, USA.

Kuntz, L. A., 1996. Fat Facts for Cookies and Crackers. Food Product Design, Virgo Publishing, USA.

Matz, S.A., 1996a. Bakery Technology and Engineering. 3rd Edn, CBS Publishers. New Delhi, India, pp: 89-90.

Matz, S.A., 1996b. Bakery Technology and Engineering. 3rd Edn, CBS Publishers. New Delhi, India, pp: 163-169.

Matz, S.A., 1996c. Bakery Technology and Engineering. 3rd Edn, CBS Publishers. New Delhi, India, pp: 123-130.

Matz, S.A., 1996d. Bakery Technology and Engineering. 3rd Edn, CBS Publishers. New Delhi, India, pp: 134-143.

Matz, S.A., 1996e. Bakery Technology and Engineering. 3rd Edn, CBS Publishers. New Delhi, India, pp: 151-159.

Matz, S.A., 1996f. Bakery Technology and Engineering. 3rd Edn, CBS Publishers. New Delhi, India, pp: 88-92.

Nairn, J.G., 1993. Solutions, emulsions, suspensions and extracts. 19th Edn, pp: 1509-1515.

Weese, J., 2005. Extension Food Scientist, Associate Professor, Nutrition and Food Science, Auburn University, Alabama Cooperative, Extension system, USA.

Wilkes, A.P., 1992. Contributing Editor, Food Product Design, Virgo Publishing, USA. Website:www. food productdesign.com