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Significance of Emulsifiers and Hydrocolloids in Bakery Industry

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Review

Abstract

Nowadays, the use of additives has become a common practice in the baking industry. In this paper, the relevance two groups of these compounds (emulsifiers and hydrocolloids) for bakery applications are described. Emulsifiers are commonly added to commercial bakery products to improve bread quality and dough handling characteristics. Some frequently used emulsifiers are diacetyl tartaric acid esters of monodiglycerides and lecithin, which are known as dough improvers, and monoacylglycerols, which are applied as antistaling agents or crumb softeners. Food hydrocolloids are high-molecular weight hydrophylic biopolymers used as functional ingredients in the food industry. In the baked goods, hydrocolloids have been used for retarding the staling and for improving the quality of the fresh products. They help to minimize the negative effects of the freezing and frozen storage. An improvement in wheat dough stability during proofing can be obtained by the addition of sodium alginate, κ-carrageenan and xanthan gum. Carboxymethylcellulose, hydroxypropylmethylcellulose and alginate can be added as anti-staling agents that retarded crumb firming.

Keywords: emulsifiers, hydrocolloids, bakery products, review

Introduction

Additives are extensively used in the baking industry (Haros et al. 2002). The need for their use arises due to the fact that numerous benefits are associated with their use (Ashgar 2006). With this objective, a large number of these substances of various chemical structures have been used (Rosell et al. 2001). Some additives are focussed on improving dough machinability, like pentosanases (Bárcenas et al. 2003), others on bread volume and crumb texture, such as different emulsifiers like sodium stearoyl lactylate, and monoacylglycerols (Twillman and White 1988; Stampfli and Nersten 1995). Moreover, other improvers, such as hydrocolloids (Armero and Collar 1996; Davidou et al. 1996) and enzymes (namely different amylases, hemicellulases and lipases) (Haros et al. 2002; Rosell et al. 2001) are added in order to extend the freshness of the product during storage (Bárcenas et al. 2003). Importance of two types of these compounds (emulsifiers and hydrocolloids) in the bakery industry is discussed in the following sections.

Emulsifiers

In general, emulsifiers are essential for the baking process and have been applied to baking for a long period (Miyamoto 2005). These additives belong in the general class of compounds called surface-active agents or surfactants. They are substances possessing both lipophilic and hydrophilic properties (Flack 1987; Krog 1981; Stampfli 1995). This particular chemical structure enables emulsifiers to concentrate at the oil/water interphase and thus contribute to the increased stability of a thermodynamically unstable system. The effect of the emulsifying agents exceeds their emulsifying capacity, as their amphiphilic character provides the possibility of forming complexes with starch and proteins. However, emulsifiers include compounds with a completely different chemical structure, and therefore with diverse mechanisms of action, and in turn different effects in dough and bread (Goméz et al. 2004). Emulsifiers are therefore classified either as ionic or nonionic. The potential for ionization is based on the electrochemical charge of the emulsifiers in aqueous systems. Nonionic emulsifiers (monoglycerides, distilled monoglycerides, epoxylated monoglycerides, sucrose esters of fatty acids) do not dissociate in water due to their covalent bonds. Ionic emulsifiers may be anionic (diacetyl tartaric acid esthers of monoglycerides, sodium stearoyl-2- lactylate) or cationic, but cationic emulsifiers are not used in foods. Amphoteric emulsifiers (lecithin) contain both anionic and cationic groups and their surface-active properties are pH-dependent (Stampfli 1995).

Role of emulsifiers in manufacture of baked goods

In generally, for the baking industry the characteristics which are expected of emulsifiers are mentioned: improved dough handling including greater dough strength; improved rate of hydration and water absorption greater tolerance to resting time, shock and fermentation; improved crumb structure: finer and closer grain, brighter crumb, increased uniformity in cell size; improved slicing characteristics of bread; crust thickness; emulsification of fats and reduction of shortening; improved symmetry; improved gas retention resulting in lower yeast requirements, better ovenspring, faster rate of proof and increased loaf volume; longer shelf-life of bread (Stampfli 1995; Goméz et al. 2004; Selomulyo and Zhou 2007).

Emulsifiers are usually applied in the baking industry as dough strengtheners (such as sodium stearoyl-2-lactylate and diacetyl tartaric acid esters of monodiglycerides) and crumb softeners (for example monoacylglycerols and glycerol monostearate) (Gray and Bemiller 2003; Goméz et al. 2004), although some emulsifiers (i.e. sodium stearoyl-2-lactylate) show properties for both dough strengthening and crumb softening (Stampfli 1995).

The mechanism of dough strengthening due to emulsifiers, is not fully understood (Kokelaar 1995; Stampfli 1995). One theory suggests emulsifiers conferred strength to wheat dough due to the complex formation with gluten proteins (Miyamoto 2005; Goméz et al. 2004). The emulsifier may bind to the protein hydrophobic surface promoting aggregation of gluten proteins in dough. A strong protein network results in better texture and increased volume of bread (Miyamoto 2005; Ribotta et al. 2008). Another theory is based on the ability of polar emulsifiers to form liquid–crystalline phases in water, which associates with gliadin. These structures may contribute to dough elasticity allowing gas cell to expand, thus resulting in an increased volume of baked food (Ribotta et al. 2008).

Fresh bread is a product with a short shelf-life and during its storage a number of chemical and physical alterations occur, known as staling. As a result of these changes, bread quality deteriorates gradually as it loses its freshness and crispiness while crumb firmness and rigidity increase (Ashgar 2006). It was demonstrated that emulsifiers inhibit the firming of the crumb, associated with staling (Azizi and Rao 2005). Their effect on retardation of baked goods staling has been proposed to result from their interaction with starch (Miyamoto 2005; Ribotta et al. 2008; Azizi and Rao 2005), retarding the retrogradation process, and their blocking of moisture migration between gluten and starch which prevents starch from taking up water (Krog 1981; Rao et al. 1992; Selomulyo and Zhou 2007). Emulsifiers can also have an affect on the moisture distribution between the protein and starch fraction of a food systém. A decrease in the amount of water imbided by the starch makes more water aviable for hydratation of the gluten, and this too is thought to contribute to staling retarding (Van Haftenm and Patterson 1979; Pisesookbunterng and D'appolonia 1983; Selomulyo and Zhou 2007).

Bakery applications of selected emulsifiers

Each of the emulsifiers applied in bakery industry contributes something to all of the above dough and baked goods properties to greater or lesser degrees depending on the particular emulsifier. The most commonly used emulsifiers and their likely contribution to dough character and bakery products quality are as follows (Cauvian and Young 2001):

Sodium stearoyl-2-lactylate (SSL) is an anionic oil-in-water emulsifier that is used to improve the quality of bread. This emulsifier improves mixing tolerance and resistance of the dough to collapse when added to dough. Concerning the final product, this substance improves loaf volume and endows it with resilient texture, fine grain, and slicing properties (Ribotta et al. 2008; Azizi and Rao 2005; Cauvian and Young 2001). SSL may provide the gas-dough interface with certain properties which are favourable for the stability of the gas bubbles in bread dough throughout the breadmaking process (Kokelaar 1995). The positively influence of SSL on the pasting parameters associated with a significant delay in bread firming was also observed (Collar 2003). This substance can decrease the effects of frozen storage on rheological properties, but it was not effective in reducing the dough proofing time (Matuda et al. 2005).

Diacetylated tartaric acid esters of mono- and diglycerides of fatty acids (DATA ESTERS, DATEM) are anionic oil-in-water emulsifiers that are used as dough strengtheners (Selomulyo and Zhou 2007). Levels of use are usually up to 0.3% flour weight in a variety of bread and fermented products (Cauvian and Young 2001). When added to dough, they improve mixing tolerance, gas retention, resistance of the dough to collapse, improves loaf volume (Selomulyo and Zhou 2007; Ribotta et al. 2004) and endow the crumb with a resilient texture, fine grain as well as good slicing properties (Inoue et al. 1995; Selomulyo and Zhou 2007). Haehnel et al. (1995) reported that DATEM formed hydrogen bonds with starch and glutamine is capable to promote the aggregation of gluten proteins in dough by binding to the protein hydrophobic surface. This produces a strong protein network, which in turn will produce bread with a better texture and increased volume. This emulsifier may also form lamellar liquid-crystalline phases in water, which associates with gliadins (Ribotta et al. 2004). The formation of such structures allows the expansion of gas cells and contributes to dough elasticity (Selomulyo, V. O., and Zhou, 2007), resulting in increased bread volume (Primo-Martin. 2006, 83). It was also found that maximum improvement in loaf volume can be reached in the case of weak wheat flours (Ravi et al. 2000). The inclusion of DATEM in frozen dough produces bread with increased loaf volume and form ratio (i.e. height/width) values (Wolt and D'Appolonia 1984; Ribotta et al. 2001 and 2004; Selomulyo and Zhou 2007), lower crumb firmness and retards the rate of staling. The function of DATEM as a crumbsoftening agent is closely related to their interaction with starch, particularly with the linear amylase molecules, but also with amylopectin. The formation of these complexes inhibits bread staling either by preventing amylose or amylopectin retrogradation or by having fewer ß-type amylose nuclei that could promote amylopectin retrogradation (Selomulyo and Zhou 2007).

Lecithins are a group of naturally occurring, complex phospholipids (Cauvian and Young 2001). They have been reported to reduce staling and to have the advantage of being amenable to modification for specific applications (Forssell et al. 1998; Gray and Bemiller 2003). They are also used in baguette and other crusty breads to improve dough gas retention to a degree and contribute to crust formation (Cauvian and Young 2001). The main commercial source of lecithin is plant seed especially soybean (Dickinson 1993). Soya lecithin hydrolysate complexed effectively with starch amylose and retarded wheat starch crystallization due to its content of lysophospholipids. In addition, lecithins slow down the amylopectin crystallization because of their high content in lysophospholipids. This may explain why the effect brought about by enriched lecithins in lysophospholipids presented a better antistaling capacity (Goméz et al. 2004). Oat lecithin retarded staling significantly more than did soy lecithin, but did not affect crystallization in starch gels (Forssell et al. 1998; Gray and Bemiller 2003).

Monoacylglycerols are the most widely used fat-based emulsifiers in bread and other food systems (Van Haftenm and Patterson 1979). These substances can be applies to delay staling and as crumb softeners in bakery products (Huang and White 1993, Stampfli et al. 1996). The generally accepted theory about the mechanism by which crumb softeners retard the firming process is based on the ability of monoglycerides to form complexes with amylose. Tamstorf (1983) reported that this amylose monoglycerol inclusion complex is insoluble in water. Therefore, the part of the amylose which is complexed by the monoglycerides does not participate in the gel formation which normally occurs with the starch in the dough during baking. Therefore, upon cooling, the complexed amylose will not recrystallize and will not contribute to staling of the bread crumb (Stampfli 1995).

Polyglycerol mono fatty acid esters (PGMFEs), synthesized with polyglycerol and fatty acids, are bio-grade emulsifiers that are safe and offer multiple functional properties such as acid resistance, salt resistance, thermostability, savoriness, and superior O/W emulsion (Miyamoto 2005). They are generally utilized in breadmaking as dough conditioners. The addition of PGMFEs containing a lauric acid moiety increases the loaf volume of the bread more than those having stearic and oleic acid moieties (Garti and Aserin 1981). However, it has not yet been elucidated how PGMFEs influence the loaf volume of the bread. Furthermore, the effects of the PGMFEs as the softeners for breadmaking have not yet been completely clarified. Recently, was reported that the PGMFEs affected the afinity of gluten and starch in the dough and that this depended strongly on the fatty acid moieties of the PGMFEs (Miyamoto et al. 2002; Miyamoto 2005).

Glycerol mono-stearate is best used in the hydrated form but can be added as a powder. It does not greatly contribute to dough gas retention of bread volume but does act as a crumb softener through its proven anti-staling effect (Cauvian and Young 2001). It was also reported that did not alter the water absorption capacity significantly, but marginally improved the stability of the dough (Ravi et al. 2000).

Sucrose ester emulsifiers (SE) consist of a hydrophilic sugar head and one or more lipophilic fatty acid tails (Selomulyo and Zhou 2007). The addition of SE in dough formulations produces bread with a fine and soft crumb structure, high volume, extended shelf life, increased dough mixing tolerance, and improved freeze–thaw stability (Hosomi et al. 1992; Barrett et al. 2002). SE can interact with starch and proteins (Gomez et al. 2004) to form complexes, affecting the physical chemical properties of both ingredients. For starch, sucrose fatty acid esters interact mainly with the amylose molecules to form inclusion complexes with the helical amylose molecules during gelatinization. These complexes inhibit starch retrogradation resulting in a baked product with longer duration freshness (Pomeranz 1994; Selomulyo and Zhou 2007). Addition of SE decreased yeast damage by increasing the amount of non-frozen water in the wheat starch, which acts as a cryoprotectant for yeast cells. Furthermore, addition of SE prevented wheat protein denaturation during freezing. As a result, damage to the baking properties of the frozen dough was minimized (Selomulyo and Zhou 2007). Blends of emulsifiers combine the functional properties of the separate ingredients. The combination of DATEM and monoacylglycerols which serves as a dough conditioner and crumb softener is one such examle (Lucca and Tepper 1994).

Hydrocoloids

One group of the most extensively used additives in the food industry are hydrocolloids (or gums) (Selomulyo and Zhou 2007). The term hydrocolloids embraces all the many polysaccharides that are extracted from plant, seaweeds and microbial sources, as well as gums derived from plant exudates, and modified biopolymers made by the chemical treatment of cellulose (Dickinson 2003). The most well know and applied in the industry polymers included in this kind of substances are alginates, carrageenans, agar, guar gum, arabic gum and carboxymethyl cellulose (Gómez-Diaz and Navaza 2003). These compounds used in food products and processing can serve as processing aids, provide dietary fiber, impart specific functional properties or perform a combination of these roles. Guar and xanthan gums, for instance, have been used at 7 % and 2 % levels, respectively, in bread to provide dietary fiber for therapeutic purposes. At a lower level of incorporation, hydrocolloids have served as additives to improve the quality of baked goods (Onweluzo et al.1999).

Role of hydrocolloids in manufacture of baked goods

In the baking industry, hydrocolloids are of increasing importance as bread improvers, they can induce structural changes in the main components of wheat flour systems along the breadmaking steps and bread storage (Selomulyo and Zhou 2007). Hydrocolloids are used either alone or in combination to achieve specific synergies between their respective functional properties (Benech 2007). Hydrocolloids when used in small quantities (<1% (w/w) in flour) are expected to increase water retention and loaf volume and to decrease firmness and starch retrogradation (Collar et al. 1999). The highly hydrophilic nature of hydrocolloids also helps to prevent the growth of ice crystals during frozen storage of products, and the migration of water from the substrate to the coating, which improves the freeze/thaw stability (Fiszman and Salvador 2003).

The presence of hydrocolloids influenced melting, gelatinization, fragmentation, and retrogradation starch processes. These effects were shown to affect pasting properties, dough rheological behavior bread staling (Collar et al. 1999; Gómez et al. 2007). It is generally accepted that each hydrocolloid affects the pasting and rheological properties of starch in a different way. There are many possible factors involved in this, the most important being the molecular structure of hydrocolloids and/or ionic charges of both starches and hydrocolloids (Alvarez et al. 2008). A reduction of pasting temperature was achieved when 1 % alginate was added implying an earlier beginning of starch gelatinization and subsequently an increase in the availability of starch polymers as amylase substrate for dextrinization during the baking period. Xanthan gum and pectin increased cooking stability and guar gum and cellulose derivatives increased viscosity values during cooling while alginate, xanthan gum and carrageenan showed the opposite effect (Collar et al. 1999; Rojas et al. 1999).

Hydrocolloids have a neutral taste and aroma which permits a free flavour release of all recipe components (Benech 2007). They provide an unctuous body to fat-reduced products (Gimeno et al. 2004) in which compensate for the low fat content with their water-binding ability and texturising properties (Benech 2007). These compounds have been used as gluten substitutes in the formulation of gluten – free breads due to their polymeric structure (Gomez et al. 2007).

Bakery applications of selected hydrocolloids

Tree gum exudates

Arabic gum is a water-soluble dietary fiber derived from the dried gummy exudates of the stems and branches of *Acacia senegal* (Nasir et al. 2008). The highly branched structure of this hydrocolloid gives rise to compact molecules with a relatively small hydrodynamic volume and as a consequence gum solutions become viscous only at high concentrations (Selomulyo and Zhou 2007). It was demonstrated that the additon of arabic gum concludes in increased loaf volume and bread characteristics (Asghar et al. 2005). The improvement of bread external appearance and its internal characteristics such as texture, cell wall structure, colour and softness were also described (Sharadanant and Khan 2003a,b).

Karaya gum is a natural gum exudate of *Sterculia urens*, a tree native to *–Ibdia* belongs to the family *Sterculiaceae*. It is widely used in food industry as food additive. The wider application of this gum due to its unique features such as high sweeling and water retention capacity, high viscosity properties, inherent nature and abundant availability (Le Cerf et al. 1990, Babu et al. 2002). This hydrocolloid can be used in bakery products for improve tolerance to variations in water addition and mixing time. Due to its water-binding capacity, it also slows down aging, extending the shelf-life of baked goods (Verbeken et al. 2003).

Algal sources

Kappa carrageenan is a sulphated polysaccharide extracted from certain red algae (Imeson, 2000). When it is used as a dough additve, has an ability to improve the specific volume of the bread due to its interactions with gluten proteins (Leon et al. 2000). The presence of this hydrocolloid also concluded in increased the moisture content in the final bread (Leon et al. 2000; Selomulyo and Zhou 2007).

Alginates are a polyuronic saccharides isolated from the cell walls of a number of brown seaweed species (Brownlee et al. 2005). They are used to stabilize bakery toppings and icings, as well as to prevent the sticking of products to wrapping paper. Other bakery applications in which alginates are used include meringues and fruit or chiffon pie fillings (Glickman, 1987). Addition of these compounds provides bakery cream with freeze/thaw stability, reduced syneresis, improves shelf life and moisture retention in bread and cake mixes (Brownlee et al. 2005).

Agar is a hydrophilic colloid extracted from seaweeds of the *Rhodopyceae*, including order *Gelidiales* (*Gelidium and Pterocladia*) and order *Gracilariales* (*Gracilaria* and *Hydropuntia*) (Pereira-Pacheco et al. 2007). Because agar gels can hold large amount of soluble solids such as sugar without allowing crystallization, becoming opaque, or losing adhesive properties, they are used widely in the preparation of bakery glazes, icings, toppings etc. For the same reasons, they are also effective in the formulation of good quality piping jellies for fillings in doughnuts, filled cakes, etc. (Glicksman, 1987).

Seeds

Guar gum (G) is a galactomannan derived from the seed of a leguminous plant *Cyamopsis tetragonolobus* (Slavin and Greenberg 2003). Its solutions are highly viscous at low concentrations and useful in thickening, stabilization and water-binding applications (Miyazawa and Funazukuri 2006; Selomulyo and Zhou 2007). In bakery products, G is used to improve mixing and recipe tolerance, to extend the shelf life of products through moisture retention and to prevent syneresis in frozen foods and pie fillings (Selomulyo and Zhou 2007). Influence of this gum in frozen dough is widely discussed. Mandala (2005) described that the addition of G was found to be disadvantageous. It yielded a product with less desirable properties compared with control samples as it lowered the specific volume and porosity of bread, and produced a rubbery crust with low crust thickness (Mandala 2005). In contrast, Ribotta et al. (2001) found that the addition of guar gum in frozen dough produced bread with a higher volume, a more open crumb structure with higher percentage of gas cells than those prepared without it. Also it was concludes that G may delay bread staling by softening effect likely due to a possible inhibition of the amylopectin retrogradation, since G preferentially binds to starch. It is explained by influence on formation of amylose network avoiding the spongy matrix creation (Shalini and Laxmi 2007).

Locust bean gum is a natural hydrocolloid extracted from the seeds of carob tree (*Ceratonia siliqua L.)* (Goncalves and Romano 2005; Bonaduce et al. 2008). Its application for bakery purposes results in higher baked product yields; it improves the final texture and adds viscosity in dough. Furthermore, it appears effective in lowering serum lipids and in dietary treatment of diabetics (Mandala et al. 2007).

Microbial sources

Xanthan gum (X) is extracellular polysaccharide secreted by the bacterium, *Xanthomonas campestris* (Selomulyo and Zhou 2007). This hydrocolloid contributes smoothness, air incorporation and retention, and recipe tolerance to batters for cakes, muffins, biscuits and bread mixes. Baked goods have increased volume and moisture, higher crumb strength, less crumbling and greater resistance to shipping damage (Svorn 2000). At low concentrations provides storage stability and water binding capacity. Its pseudoplastic behavior is important in bakery products during dough preparation, i.e. pumping, kneading and moulding. It prevents lump formation during kneading and improves dough homogeneity (Collar et al. 1999). X induces cooking and cooling stability in wheat flour and improves the freeze/thaw stability of starch-thickened frozen foods (Alvarez et al. 2008). X also improves the cohesion of starch granules, thus providing a structure to these products. It is used to increase water binding during baking and storage and thus prolongs the shelf life of baked goods and refrigerated dough. (Katzbauer 1998; Khan 2007). The addition of X into a frozen dough formulation can strengthen the dough by forming a strong interaction with the flour proteins. It also increases water absorption and the ability of the dough to retain gas, increasing the specific volume of the final bread and the water activity of the crumb (Collar et al. 1999; Selomulyo and Zhou 2007). The increase in specific volume, as well as high porosity (open structure) and softer crust, however, are obtained only at low concentrations of X (0.16 % flour basis). Increased X concentration but resulted in a decrease in specific volume compared to that of the control samples (Mandala 2005). X can also be used in soft baked goods for the replacement of egg white content without affecting appearance and taste. It is also used in prepared cake mixes to control rheology and gas entrainment and to impart high baking volume. Solid particles like nuts are prevented from settling during baking (Katzbauer 1998; Khan 2007).

Gellan gum is an anionic deacetylated exocellular polysaccharide (Hamcerencu et al. 2008) produced by fermentation of *Sphingomonas paucimobilis* (formerly *Pseudomonas elodea*) (Xu et al. 2007). This gum is used in a variety of food that includes water-based gels, confectionery, jams and marmalades, pie fillings and puddings, fabricated foods and dairy products (Bajaj and Singhal 2007).

Modified polysaccharides

Hydroxypropyl methylcellulose is water-soluble fiber which has been used in food for decades to enhance the manufacturing process and improve food product qualities (Deshmuk 2007). This compound is obtained by the addition of methyl and hydroxypropyl groups to the cellulose chain (Sarkar and Walker, 1995). The etherification of hydroxyl groups of the cellulose increases its water solubility and also confers some affinity for the non-polar phase in doughs. Hence, in a multiphase system like bread dough, this bifunctional behaviour allows the dough to retain its uniformity and to protect and maintain the emulsion stability during breadmaking (Selomulyo and Zhou 2007). It was also demonstrated that using of this celullose derivate in breadmaking improves its quality (loaf volume, moisture content, crumb texture, and their sensorial properties). In addition, this hydrocolloid is a good antistaling agent for retarding the crumb hardening (Armero and Collar, 1996; Rosell et al., 2001a; Guarda et al., 2004; Bárcenas and Rosell, 2005). Its effect should be attributed to their water retention capacity, and a possible inhibition of the amylopectin retrogradation (Collar et al., 2001; Guarda et al., 2004).

Carboxymethyl cellulose is a cellulose derivative with carboxymethyl groups bound to some of the hydroxyl groups present in the glucopyranose monomers that forms cellulose backbone (Selomulyo and Zhou, 2007). This celullose derivate is used in baked goods mostly to retain moisture, to improve the body or mouth-feel of the products, to control sugar and ice crystallization (Chinachoti, 1995), to protection against leavening losses in cake mixes, to improving volume and uniformity of baked products, and to increase of the shelf life of cereal products (Gimeno et al. 2004).

Animal sources

Chitosan (deacetylated chitin), a polycationic biopolymer is commercially prepared from shellfish-processing waste and is non-toxic, biodegradable and biocompatible (Rudrapatnam and Farooqahmed 2003). Its addition to bakery products creates opportunity to combine its beneficial technological properties with beneficial health-promoting behaviour (Kerch et al. 2008). It exhibits antibacterial and antifungal activity and has therefore received attention as a potential food preservative of natural origin (Kanatt et al. 2008). The positive effects of chitosan on bread staling was also determined. It was stated that this hydrocolloid increases water migration rate from crumb to crust, prevents amylose-lipid complexation, and increases dehydration rate both for starch and gluten (Kerch et al. 2008).

Milk proteins. Whey proteins are primarily used in cereal products to improve nutritional properties. Whey protein concentrate is considered to be the most efficient wheat protein supplement (Kenny et al. 2000) and also increases calcium content when added to cereal products (Renz-Schauen and Renner 1987). Whey proteins exert negative effects on bread quality, by depressing loaf volume and increasing crumb firmness. However, modification of the extent of protein denaturation by heat treatment or the use of high hydrostatic pressure can counteract these effects (Kadharmestan 1998; Kenny et al. 2000). Acid casein has drastic effects on bread volume, which cannot be eliminated by heat treatment (Erdogdu-Arnoczky et al. 1996). Sodium caseinate, which has excellent surfactant properties, attributed to the amphiphilic nature of the protein, is used as an emulsifier, thickener and foaming agent and is known to increase water absorption in flour systems. It was also demonstrated that this compound was very effective as an improver in wheat bread prepared by a straight dough baking process (Kenny et al. 2000). Milk protein products may be also incorporated into the flour base for pasta manufacture to improve nutritional quality and texture. Products fortified by addition of sodium or calcium caseinate, low calcium co-precipitate or whey proteins concentrate prior to extrusion include macaroni and pasta. Enrichment of pasta flours with non-denatured whey protein products results in firmer cooked noodles which are also more freeze-thaw stable and suitable for microwave cooking. Imitation pasta-type products containing substantial proportions of milk protein have also been manufactured (Ennis and Mulvihill 2001).

Conclusion

Additives are used in bakery to facilitate processing, to compensate for variations in raw materials, to guarantee constant quality, and to preserve freshness and food properties (Ribotta et al. 2008). This paper is oriented to application two types of these compounds (emulsifiers and hydrocolloids) in bakery industry. In general added emulsifiers improve loaf volume and texture in bread and prolong shelf life (Potgieter 1992; Kokelaar 1995; Azizzi, 2003). The reduction in crumb firming rate with emulsifiers has been reported by several authors (Joensson and Toernase 1987; Krog et al. 1989). Hydrocolloids are also increasing importance as bakery product improvers (Rosell et al. 2001). They are widely used in baked goods to enhance dough handling properties, to increase overall quality of the fresh products and to extend shelf-life of stored goods (Keskin et al. 2007). But the great variation in the effects promoted by the different emulsifiers and hydrocolloids necessitates a systematic study about the influence of a range of these compounds with different structures and in consequence diverse functionalities in their performance in the baked goods (Goméz et. al.2004; Guarda et al. 2004).

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