PREPARATION AND EVALUATION OF FUNCTIONAL PROCESSED CHEESE SPREADS

By

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B.Sc. Agric. Sci. (Dairy Science), Fac. Agric., Cairo Univ., 2005

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Submitted in Partial Fulfillment of the Requirements for the Degree of

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APPROVAL SHEET

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ABSTRACT

Conjugated linoleic acid (CLA) and its isomers are fatty acids found in meat, milk and dairy products. These fatty acids may have potential biological properties interesting for human health. It is well established that milk and dairy products are one of the major dietary sources of CLA but no work in Egypt has been conducted to assess the CLA content in different Egyptian processed cheese spreads and the factors that affect CLA content in these cheeses. Therefore, in the present study, a survey of Egyptian processed cheeses spreads available in the local market and its content of the CLA was done. Moreover, the effect of heating conditions and protein fractions on CLA content was studied in addition to studying the properties of the prepared processed cheese spreads rich in CLA content. Fifteen brands of processed cheese products were collected from the local market and analyzed. The obtained results revealed that CLA content in cheese brands labeled "containing vegetable oils" ranged from 0.0 to 0.138% of the total fatty acids with an average of 0.056% while CLA content in brands labeled "containing milk fat" ranged from 0.016 to 0.428% with an average of 0.158%. Concerning the effect of heating conditions and milk protein fractions, the obtained results clearly indicated that no significant effect on conjugated dienes could be detected as a result of heating butter oil or vegetable oils emulsion in either casein or whey protein concentrate solutions. Also it was observed that high pH and the presence of whey proteins would increase the development of conjugated dienes in simulated cheese models during heat treatment. In regards to the properties of the prepared processed cheese spread rich in CLA, the obtained results indicated that the use of increased percentage of CLA rich cheese curd in the cheese spread mixture decreased the total organoleptic scores of these cheeses inspite of its healthy effect.

Key words: conjugated linoleic acid, processed cheese ,heat-treatment, vegetable oils, functional processed cheese spreads

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تحضير وتقييم مفرود جبن مطبوخ وظيفي

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المستخلص العربي

حمض اللينوليك المرتبط ومشابهاته عبارة عن أحماض دهنية موجودة فى اللحوم والألبان ومنتجاتها وهذه الأحماض الدهنية لها خصائص حيوية مهمه بالنسبة لصحة الانسان. ومن المعروف أن اللبن ومنتجات الألبان من أهم المصادر الغذائية الرئيسية الغنية بحمض اللينوليك المرتبط. وحيث أنه لم تجر أي دراسات في مصر لتقييم نسب حمض اللينوليك المرتبط فى مفرودات الجبن المطبوخ المصرية المختلفة ولا لدراسة العوامل التى تؤثر على هذه النسب فى الجبن المطبوخ المصري المتاحة فى السوق المحلي فقد تم دراسة هذا الجزء بالرسالة. هذا بالإضافة إلى دراسة تأثير ظروف التسخين وشقوق بروتين اللبن على محتوى حمض اللينوليك المرتبط، وكذلك دراسة خصائص مفرودات الجبن المطبوخ المصنعة والغنية فى محتواها من حمض اللينوليك المرتبط.

تم جمع خمسة عشر نوع من الجبن المطبوخ من السوق المحلية وتحليلها. وأوضحت النتائج المتحصل عليها أن الجبن المحتوية على زيوت نباتية تراوحت نسبة هذه الأحماض بها من صفر % إلى ٠.١٣٨ % بمتوسط ٠.٠٥٦ % .

بينما تراوحت هذه النسب فى الجبن المحتوية على دهن اللبن من ٠.٠١٦ % إلى ٠.٤٢٨ بمتوسط ٠.١٥٨ وقد أشارت النتائج المتحصل عليها عند دراسة تأثير ظروف التسخين وشقوق بروتين اللبن على محتوى حمض اللينوليك المرتبط إلى أنه لايوجد تأثير معنوي على محتوى الروابط الزوجية المتبادلة لمستحلب دهن اللبن أومستحلب الزيوت النباتية في أي من محاليل الكازين أو مركزات بروتينات الشرش، أظهرت النتائج أن ارتفاع درجة الحموضة فى وجود مركزات بروتينات الشرش أدى إلى زيادة الروابط الزوجية المتبادلة في نماذج محاكاة الجبن المطبوخ أثناء التسخين. وعند دراسة مفرود الجبن المطبوخ المصنع من مخلوط مرتفع في محتواة من حمض اللينوليك المرتبط، أشارت النتائج التي تم الحصول عليها إلى أن استخدام نسبة عالية من الخثرة العالية فى محتواها من حمض اللينوليك المرتبط في خليط مفرود الجبن أدى إلى انخفاض مجموع درجات التقييم الحسي لهذه الأجبان على الرغم من تأثيرها الصحي العالي.

الكلمات الدالة: حمض اللينوليك المرتبط، الجبن المطبوخ، المعاملة الحرارية، الزيوت النباتية، مفرود جبن مطبوخ وظيفي.

CONTENTS

INTRODUCTION

Conjugated linoleic acid (CLA) is a collective term referring to the positional and geometric conjugated dienoic isomers of linoleic acid (LA), which are found as minor constituents of the lipid fraction of meat, milk and dairy products (Line *et al*., 1995). In CLA, the double bonds are conjugated and are not separated by a methylene group as in case of LA. Each of the double bonds can be in the cis or trans configuration and the combination of cis – trans double bonds in the molecule accounts for the different geometric isomers. The cis 9, trans 11 isomer is the principal dietary form of CLA, but lower levels of the other isomers (trans 10, cis 12; trans 9, trans 11 and trans 10, trans 12 isomers) are also present in CLA food sources (Griinari *et al*., 1998). The levels and isomers distribution of CLA in beef and milk can be affected by the rumen microbial population and animal feed composition, as recently reviewed elsewhere (Mac Donald, 2000). Briefly, milk from cows grazing pasture have higher concentrations of CLA compared with those fed forage or grain, also CLA levels in milk are subject to seasonal variations.

Ha *et al*. (1990) have reported that CLA has anticarcinogenic properties. The cis 9, trans 11 (c-9, t-11) CLA isomer was found to be biologically active when incorporated into mouse forestomach phospholipids. Their observations also indicated that CLA could serve as an effective antioxidant. The conjugated linoleic acid (CLA) content of cheeses ranged from 3.59 to 7.96 mg/g of lipid. Blue, Bric, Edam and Swiss cheeses had significantly higher conjugated linoleic acid content than the other cheeses. Sharp cheddar cheeses tended to have

higher CLA content than the medium cheddar cheeses (Lin *et al*., 1995). Very little data is recorded on CLA content in processed cheeses. Ha *et al*. (1989) have reported a higher levels of CLA in processed cheeses, such as cheese Whiz, as compared to natural cheddar cheese. Although the increased CLA concentration in processed cheese has been attributed to heat treatment and / or the presence of food additives such as whey protein concentrate no study has yet been conducted to directly show that processing conditions and / or food additives can increase the level of CLA in processed cheese. In Egypt, processed cheese and processed cheese spreads in particular, is considered one of the main types of cheeses that consumed in a large amount and by a large number of population and in particular by children, due to its delicious flavor and its nutritional value. However, no one can declare how much CLA can be found in this cheese due to the rare studies in this respect. In fact there is only one study in Egypt dealt with CLA content in milk and some dairy products namely cream, butter and ghee (Abd El-mobdy, 2009). However this study did not address the CLA content in processed cheese. Therefore this investigation was carried out to:

1. Monitor the composition of local processed cheese varieties with particular reference to their CLA content and dienes as a simple measure for CLA content of these products.
2. Study the effect of heating conditions and milk protein fractions on the CLA content in simulated processed cheese models.
3. Study the properties of the prepared processed cheese spread rich in CLA.

REVIEW OF LITERATURE

Conjugated linoleic acid (CLA) is a group of naturally-occurring, essential fatty acids. Fatty acids are the building blocks from which fats are composed. Fatty acids referred to as "essential fatty acids" are those which are not produced by the human body but are essential for normal functioning, and therefore, must be ingested.

To clarify, the fats which have been determined to be detrimental to human health are trans fatty acids which are artificially processed through hydrogenation. These are the fats found, for example, in fried foods. This type of trans fatty acid is associated with the concentration of cholesterol in human blood, causing detrimental effects on human health. In contrast, CLA is created in the rumen of animals.

Conjugated linoleic acid, or CLA, is actually one type of a naturally-occurring fatty acids, but it has a unique and unusual molecular form. Linoleic acid is a molecule formed around a kinked chain of carbon atoms. Two of these carbon atoms in the chain are linked with double bonds. But when certain chemicals are introduced, the result is that only single bonds remain between the carbon atoms and that the kinks in the chain are rearranged. This single bond form is known as conjugated linoleic acid or conjugated fatty acid. The replacement of those two bonds and resulting alterations in the kinks of the carbon chain can take on any one of several dozen forms, varying in where that extra bond reattaches and where kinks form. Each

molecular combination is known as an isomer and each isomer of conjugated linoleic acid is referred to different numbers. Of the multiple isomers of conjugated linoleic acid, two are currently being studied for their impacts on animal and human health. Of the two, the most prevalent form is known as C18:2 n-9 cis, 11 trans, referred to by scientists as 9-11. This CLA isomer is naturally occurring. It is produced by bacteria in the rumen, or first stomach, of ruminant animals. Thus isomer 9-11 is naturally occurring in milk fat and meat. It is also this isomer that has received considerable attention because of claims made of its multiple health effects (Greenberg and Klasma, 2002).

1. Sources of C LA

In the past, CLA was far more abundant in the diets of people in the North America than it is today. Dr. Zahir Mir, from the Lethbridge Research Centre of Agriculture and Agri-Food Canada, estimates that CLA has diminished over the past 50 years from the diet of most North Americans from about three grams per day to about one gram per day (Greenberg and Klasma, 2002).

Why has CLA dropped so dramatically from our diets? Changes in societal views of foods, fats and healthy eating is one reason. Our society's claimed aversion to fat consumption has resulted in a diet that is very low in animal fats. So the food industry currently emphasizes no-fat or low-fat foods, eliminating many sources of naturally-occurring CLA from the