Beverage

Optimizing conditions for enzymatic clarification of banana juice

Fruit juices are now-a-days preferred than caffeine-containing beverages such as coffee, tea or carbonated soft drink. Banana, with its widely appreciated flavour and aroma, is able to compete in the market, either as banana juice or as mixtures with other juices. However, raw banana juice is turbid, gray in colour, very viscous and tends to settle during storage, and therefore, it must be clarified prior to commercialization. The scientists in Malaysia worked on the optimization of the enzymatic clarification process of banana juice using response surface methodology. During experiments banana juice was treated with pectinase at various enzyme concentrations (0.01-0.1%), temperatures (30-50°C) and time (30-120min) of treatment. The effect of these enzyme treatments on filterability, clarity, turbidity and viscosity of the juice were studied by employing a second order central composite design. The coefficient of determination, $R^2$ values for filterability, clarity, turbidity and viscosity were greater than 0.900. Statistical analysis showed that filterability, clarity, viscosity and turbidity were significantly ($P<0.05$) correlated to enzyme concentration, incubation temperature and incubation time. Enzyme concentration was the most important factor affecting the characteristics of the banana juice as it exerted a highly significant influence ($P<0.01$) on all the dependent variables. An increase in time and/or concentration of enzyme treatment was associated with an increase in filterability and clarity, and decrease in turbidity and viscosity. Based on response surface and contour plots, the optimum conditions for clarifying the banana juice were: 0.084% enzyme concentration, incubation temperature of 43.2°C and incubation time of 80 minutes. The resulting juice has a much lower amount of pectins and a lower viscosity, which facilitates the subsequent filtration process [Lee WC, Yusof S, Hamid NSA and Baharin BS, Optimizing conditions for enzymatic clarification of banana juice using response surface methodology (RSM), J Food Eng, 2006, 73(1), 55-63].

Effect of homogenizing pressure and sterilizing condition on canned high fat coconut milk

Coconut milk plays an important role in many traditional foods of Asian and Pacific regions. Canning has been found to be a suitable process for preservation of coconut milk. The process starts from extracting the milk from grated coconut meat with or without added water. The percentage of fat is adjusted before heating at pasteurization temperature. The milk is then added with a stabilizer or emulsifier and pass through the homogenizer. Finally, it is filled in can and sterilized in the retort. Increasing homogenizing pressure from 1000 to 5000psi increases stability of coconut milk and two-stage homogenization at 1000 and 2000psi result in greater stability of coconut milk than single-stage high pressure (5000psi) homogenization. The scientists at Department of Food Engineering, King Mongkut’s University of Technology, Thailand investigated the effect of homogenizing pressure (15-27MPa) and commercial sterilizing condition (109.3-121.1°C under pressure of 5-15psi) on the quality of canned high fat (30%) coconut milk.

All heat-treated homogenized samples exhibited pseudoplastic behaviour with flow behaviour index ($n$) between 0.719 and 0.971. At similar
Blueberries (Vaccinium angustifolium Ait. and V. corymbosum Linn.) are used primarily as an ingredient in processed foods such as baked goods, dairy products and juice beverages. Soy (Glycine max Linn.) beverages blended with fruit juices are a new generation of soy products and are a convenient way to include soy protein in the regular diet as both foods contain numerous antioxidants and other phytochemicals. Soymilks and other soy beverages are often characterized as having unbalanced “beany” flavours and chalky mouthfeel. Therefore, formulation changes that enhance the overall flavour and textural characteristics of soy beverages are found to be necessary to further increase soy consumption. The scientists of USA developed formulations containing wild blueberry ingredients with sufficient soy protein (6.25g per serving) to qualify for the health claim for soy protein and reduced risks for cardiovascular disease. They also characterized chemical, physical and sensory properties of the beverages, and evaluated the possibilities of increasing consumer acceptability.

The flavour of blueberries could mask beany flavours in soy beverages and thus broaden the appeal of soy. Four formulations were tested in a 2×2 design. Two sources of soy protein (isolate and soymilk powder) and two sweeteners (brown rice syrup and a blend of apple and white grape juice concentrates) were evaluated. All formulations contained 12g wild blueberry juice concentrate per 100g total. Total anthocyanins and phenolics were measured spectrophotometrically; antioxidant activity was assessed with the DPPH method. Colour, soluble solids, titratable acidity (TA), viscosity, and pH were also measured. A ten-person descriptive panel evaluated flavour, aroma and textural attributes. Sixty-five consumers rated colour, flavour, texture, and overall acceptability. Pasteurized beverages averaged 35mg of anthocyanins per 100g. TA and Brix/acid ratio were highest in the soy isolate-juice blend product. Viscosity was lowest in the soy isolate and rice syrup formulation. The descriptive panel rated the isolate-juice sample as having more sweetness and blueberry flavour; soymilk samples had higher painty, nutty and chalky ratings. Only the isolate-juice blend received mean hedonic scores above like slightly [Potter RM, Dougherty MP, Halteman WA and Camire ME, Characteristics of wild blueberry-soy beverages, LWT-Food Sci Technol, 2007, 40(5), 807-814].
### Purified sugar concentrate from a residue of citrus pigments recovery process

A recent interest of researchers is to highlight the potential of wastes conversion into profitable products, creating new segments of production and offsetting the disposal costs. With the purpose of the full exploitation of the byproducts, the scientists have focused the further utilization of a pigmented orange pulp wash residue coming from the pigments recovery process. This residue is a column percolate of the anthocyanins adsorption and contains sugars (glucose, fructose and sucrose) as main components, together with a minor amount of acids, pectins and proteins. Like all liquid wastes, once produced this residue must be treated before disposal with remarkable expenses for the industries. The efficacy of a series of unit operations based on adsorption and membrane processes to obtain a highly purified sugar concentrate was evaluated by scientist in Italy with the aim to produce an high quality natural sweetener suitable in food and beverage industries.

Pigmented orange pulp wash, the residue of citrus processing was further investigated to obtain a purified sugar concentrate applying a series of resin adsorptions and membrane techniques. The final product and the intermediates were characterized by chemical and microbiological analyses. The results have shown that anthocyanins, limonoids, flavonones and hydroxycinnamates were absent in the starting material because totally removed by the treatment with the neutral polystyrene-divinylbenzene resin used to recover the pigments; the acidity was strongly reduced through a weakly basic ion-exchange matrix while the ultrafiltration process stabilized the product by removal of enzymes and microorganisms. Eighty percent of the water was eliminated by a reverse osmosis treatment, increasing the sugar concentration by four times. The final product (28°Brix) contained about 250g/l of sugars (glucose, fructose and sucrose), 9g/l of citric acid and 1g/l of pectins. The concentrate, obtained from a residue that otherwise must be disposed, was a transparent liquid of slight amber colour with a very low microbial count and could easily find application as a natural sweetener in food and beverage industries [Scordino Monica, Mauro Alfo Di, Passerini Amedeo and Maccarone Emanuele, Highly purified sugar concentrate from a residue of citrus pigments recovery process, LWT-Food Sci Technol, 2007, 40(4), 713-721].

### Impact of ecological post-harvest processing on volatile fraction of Green coffee

The method of green coffee preparation varies country-wise. The quality of green coffee depends on the species grown and on the conditions and resources in each production region. In addition to the two main types of post-harvest process, dry or wet, there are variants also. The scientists of Mexico and France characterized the green coffees produced by three variants of the wet process and a new “ecological” process for aroma using combined headspace solid-phase micro extraction/gas chromatography-mass spectroscopy (HS-SPME/GC-MS) and headspace solid-phase micro extraction/gas chromatography-olfactometry (HS-SPME/GC-O). The effect of each post-harvest processing operation on the volatile fraction of the coffee produced was studied, particularly the effect of reducing the amount of water used in the process. The comparison of the green coffees from the different treatments revealed the importance of mucilage removal in distinguishing between the samples and showed the merits of microbial mucilage removal in water to obtain coffees with a better aroma quality. These latter coffees were in fact characterized by pleasant and fruity aromatic notes, whereas those obtained after mechanical mucilage removal used in the ecological process were characterized by volatile compounds with an unpleasant note [Gonzalez-Rios Oscar, Suarez-Quiroz Mirna L, Boulanger Renaud, Barel Michel, Guyot Bernard, Guiraud Joseph-Pierre and Schorr-Galindo Sabine, Impact of “ecological” post-harvest processing on the volatile fraction of coffee beans: 1. Green coffee, J Food Comp Anal, 2007, 20(3-4), 289-296].
Utilization of whey protein hydrolysate in beverage formulation

Whey protein, a by-product recognized as a valuable food ingredient with important nutritional and functional properties is gaining acceptance as functional food ingredient. Commercial whey proteins are considered a GRAS substance for food product applications. Not only is their biological value superior to most other proteins, but whey proteins also have a high content of sulfur-containing amino acids, which support antioxidant functions. Hydrolyzed whey protein-based formulas are beneficial for infants intolerant to cow's milk protein.

Researchers at Department of Studies in Food Science and Nutrition, University of Mysore and Department of Protein Chemistry and Technology, Central Food Technological Research Institute, Mysore, India carried out studies to analyze the functional and nutritional properties of enzymatically hydrolyzed whey protein concentrate (WPC) and to formulate a beverage mix. WPC hydrolysates were produced using fungal protease and papain, at time intervals of 20, 40 and 60 minutes and were analyzed for proximate composition and functional properties. A beverage was formulated with hydrolyzed WPC, skim milk powder, cocoa, liquid glucose, sugar and vegetable fat and analyzed for physico-chemical properties, sensory attributes and keeping quality. Results revealed that the protein content of WPC was 75.6% which decreased slightly on enzyme treatment (69.6%). The water absorption capacity of WPC was 10 ml/100 g and increased in enzyme treated samples from 16 to 34 ml/100 g with increase in the time of hydrolysis. Emulsion capacity (45 ml of oil/g of control WPC) showed a decreasing trend with increasing time of hydrolysis. Enzyme treatment slightly increased the foam capacity in three samples but lowered foam stability in all. The gel filtration pattern of enzyme treated samples showed an increase in low molecular weight fractions. The amino acid profile showed higher content of methionine in samples treated with enzymes, compared to the control. The in vitro protein digestibility of untreated WPC was 25% and increased in all treated samples to varying degrees (69-70%). Formulated beverage had 52% protein, 10% fat and 6.6% ash. There were no significant differences in the sensory attributes of formulated and commercial beverage. The formulated beverage could be stored well in a PET container for 30 days [Sinha Rhicha, Radha C, Prakash Jamuna and Kaul Purnima, Whey protein hydrolysate: Functional properties, nutritional quality and utilization in beverage formulation, Food Chem, 2007, 101(4), 1484-1491].

Studies on freeze-withering in black tea manufacturing

Tea is the second largest drink consumed in the world after water. Black tea is manufactured from the tender leaves and buds of the evergreen shrub *Camellia sinensis* (Linn.) O. Kuntze. Tea manufacturing consists of four stages, namely withering, rolling, fermentation and drying. Of these, withering is the first and most important step in tea manufacture and it is the most expensive process in terms of time, money and energy. It is done to make the leaf ready, physically and biochemically, for effective rolling, fermentation and drying processes. In order to reduce the withering time during black tea manufacture, freeze-withering was attempted by researchers at UPASI Tea Research Foundation, Tea Research Institute, Valparai, Coimbatore District, Tamil Nadu, India which resulted in flaccid leaves with increased cell membrane permeability in a shorter period of time. The freeze-withered leaves had similar amounts of quality precursors as that of the conventionally withered leaves. The resultant black tea was better in quality than those manufactured without withering and after normal withering. Manufacturing of fresh leaves resulted in comparable levels of theaflavins, but the tea was not acceptable due to its harshness. Increased cell membrane permeability during freeze-withering showed that the leaf attained a sufficient degree of physical wither. The decreases in the levels of chlorophyll showed that chemical withering had also been achieved during freeze-withering, which is supported by the increased levels of caffeine. Thus, overall freeze-withering for 2-4 hours resulted in teas with better quality and cup characteristics. While, the initial investment will be high to install a freezing facility, it would reduce the cost of production in the long run [Muthumani Thomas and Senthil Kumar RS, Studies on freeze-withering in black tea manufacturing, Food Chem, 2007, 101(1), 103-106].
Dairy products prepared by utilizing peanuts need improvement in flavour and shelf-life. But food scientists have been facing problem in removing peanut odour in peanut milk. To overcome this problem, the scientists at Southern Yangtze University, China investigated a process for preparing a dried milk-like product from full-fat peanuts having a good keeping quality with excellent nutritional benefit and get the milk free from nutty odour. During experiment peanuts were roasted and then grinding was done in hot water and powdered milk was spreaded for drying. The results revealed that grinding peanuts in hot water and heating milk before spray drying reduced the green or beany flavour of milk, which is characteristic of components like hexanal and octanal. The most satisfactory conditions for preparing peanut milk powder consisted of roasting peanuts at 120°C for 10 minutes, soaking at 1:2 peanut:water (w/v) for 8 hours, grinding with hot water at 60°C, homogenizing the extract at 28 MPa and spray drying. The nitrogen solubility was markedly lower at pH 4.0-6.0 (isoelectric pH) and maximum at above pH 7 and pH 2. The mean scores for colour, flavour, taste, bitterness and acceptability of milk extracted from mildly roasted and medium roasted peanuts, were significantly \((P \leq 0.05)\) different compared to unroasted, slight dark roasted and dark roasted peanuts. Aldehydes (over 50% of total volatiles) were the major volatile compounds in peanut milk as observed by solid-phase micro-extraction method. However, it would be desirable to supplement the amino acids constituents of the peanut milk, minerals and vitamins so as to raise its nutritive value to the same level as that of cow milk. Flavours such as chocolate and vanilla, can also be added to improve the acceptability of peanut milk as a drink [Bangoura Mamadouba and Nong Zhang Guo, Removal of odours from milk prepared from peanut, *J Food Sci Technol*, 2006, 43(2), 205-209].

Decaffeination of fresh green tea leaf by hot water treatment

Searching for inexpensive and safe decaffeination methods, which leave no solvent residue, is an important topic in the tea processing field. Hot water was used to isolate caffeine from tea leaf [*Camellia sinensis* (Linn.) O Kuntze] so as to develop a new method for processing decaffeinated tea by researchers at Tea Research Institute, Zhejiang University, Hangzhou, PR China. Water temperature, extraction time and ratio of leaf to water had a statistically significant effect on the decaffeination. When fresh tea leaf was decaffeinated with a ratio of tea leaf to water of 1:20 (w/v) at 100°C for 3 minutes, caffeine concentration was decreased from 23.7 to 4.0 mg/g, while total tea catechins decreased from 134.5 to 127.6 mg/g; 83% of caffeine was removed and 95% of total catechins was retained in the decaffeinated leaf. It is considered that the hot water treatment is a safe and inexpensive method for decaffeinating green tea. However, a large percentage of tea catechins was lost if rolled leaf and dry tea were decaffeinated by the hot water treatment and so the process is not suitable for processing black tea [Liang Huiling, Liang Yuerong, Dong Junjie, Lu Jianliang, Xu Hairong and Wang Hui, Decaffeination of fresh green tea leaf (*Camellia sinensis*) by hot water treatment, *Food Chem*, 2007, 101(4), 1451-1456].
Influence of fermentation time on the development of compounds responsible for quality in black tea

Black tea is consumed throughout the world for its unique taste, briskness and flavour. Black tea is manufactured from the tender leaves of *Camellia sinensis* (Linn.) O Kuntze. Fermentation is one of the important processes in black tea manufacture. An attempt was made by researchers at UPASI Tea Research Foundation, Tea Research Institute, Valparai, Coimbatore District, Tamil Nadu, India to study the effect of fermentation time on the oxidation of individual catechins and formation of theaflavins during the fermentation process of clonal black tea manufacture.

The compounds responsible for tea quality, such as theaflavins (TFs) and thearubigins were found to increase with fermentation time. Caffeine concentration remained unchanged. The digallate equivalent of theaflavin, colour index and briskness index were found to peak at the optimum fermentation time. Polyphenols declined more quickly during the initial stages, followed by a steadily declining trend. Fermentation time had little impact on the gallic acid concentration and among the catechins, epigallocatechin oxidized fastest, followed by epigallocatechin gallate and epicatechin gallate [Muthumani Thomas and Senthil Kumar RS, Influence of fermentation time on the development of compounds responsible for quality in black tea, Food Chem, 2007, 101(1), 98-102]

Ascorbic acid degradation in normal and concentrate lemon juice during storage

It is well known that ascorbic acid (AA) or vitamin C is present in most natural juices and is used extensively in the food industry. The latter is not only for nutritional value but also for many functional contributions of AA to product quality. However, AA degradation reactions are often responsible for important quality changes that occur during the storage of foods, limiting their shelf-life, with formation of unstable intermediate compounds, such as furfural. The degradation of AA was reported to be the major deteriorative reaction that occurs during the storage of citrus juices. Hence, researchers at Department of Food Science and Biotechnology, College of Agriculture and Forestry and Department of Chemistry, College of Science, University of Mosul, Mosul, Iraq conducted studies to determine the kinetics of AA degradation by determining the thermodynamic functions of single strength (9° brix) and concentrate (50° brix) of local lemon [*Citrus limon* (Linn.) Burm. f. cv. ‘Local’] juice during storage at 25, 35, and 45°C for 4 months.

The results indicated that increases of concentrations and temperatures increased the rate of AA degradation. The calculated values of activation energies (E°) and frequency factors (A) at different brix imply that the concentration of juice does not change the mechanism of degradation. A direct equation for estimation of the shelf life of stored juice with respect to first-order losses of AA, at any specific temperature and degradation ratio, has been derived and programmed successfully [Al-Zubaidy Mazin MI and Khalil Rabah A, Kinetic and prediction studies of ascorbic acid degradation in normal and concentrate local lemon juice during storage, Food Chem, 2007, 101(1), 254-259].
Comparison between acidic and basic protein fractions from whey or milk for reduction in bone loss

In the elderly (age >70 yr) there is progressive loss of both the organic and inorganic components of bone with ageing resulting in osteoporosis. Bone loss and fracture can be prevented to a certain extent by adequate dietary calcium, but the calcium needs to be bioavailable, especially in the elderly. Milk provides a good source of calcium that is generally well-absorbed and bioavailable. Bioactive factors other than calcium, from milk, may also impact on bone. In this respect, any such factors which might lead to reduction of the rapid menopausal bone loss by as little as 3-5% could impact on the perceived risk for osteoporosis in older women.

The ability of whey acidic protein fractions to protect against bone loss due to ovariectomy (OVX) in the mature female rat was investigated by researchers of New Zealand. The bone bioactivity of these acidic protein fractions, isolated from both mineral acid whey protein concentrate (WPC) and rennet WPC, was compared with that of basic protein fractions isolated from both milk and rennet WPC. Fifty, 6-month old rats that had been ovariectomised at 5.5 months were randomized into five groups of ten each. One group remained the OVX control while four groups were each fed one of the acidic or basic protein fractions as 0.3% (w/w) of the diet, for 4 months. Ten sham-operated rats served as a second control group. Sequential measurements of bone mineral density of the spine and femur indicated that the acidic protein fraction prepared from mineral acid WPC reduced bone loss due to OVX, maintaining bone density above OVX levels at week 16 of feeding. Biomechanical data indicated that both acidic fractions tended to increase bone stiffness, and hence resistance against breaking.

The whey acidic protein fractions prepared from both rennet WPC and mineral acid WPC (Fr2 and Fr3, respectively) significantly reduced bone loss due to ovariectomy. The acidic whey protein fraction from mineral acid WPC (Fr3) showed a stronger and more significant effect on bone overall. Both acidic whey protein fractions increased bone stiffness, an effect that could have been due to the presence of bioactive compounds that preserve bone mass in this fraction.

Ovariectomy resulted in a 16% loss in bone mineral density of the femurs. Feeding Fr2 or Fr3 reduced this loss to 7% or less. If a similar reduction in bone loss could be induced in females during menopause, the risk for osteoporosis and future fractures would be substantially reduced [Kruger MC, Poulsen RC, Schollum L, Haggarty N, Ram S and Palmano K, A comparison between acidic and basic protein fractions from whey or milk for reduction of bone loss in the ovariectomised rat, Int Dairy J, 2006, 16(10), 1149-1156].

Antihypertensive activity of fermented milk

Hypertension is an important problem of great concern in our society given its high prevalence and its role in cardiovascular diseases. The rennin-angiotensin-aldosterone system is a key factor in the maintenance of arterial blood pressure. Angiotensin-converting enzyme (ACE) plays an important role in the regulation of arterial blood pressure and inhibition of this enzyme can generate an antihypertensive effect. In fact, ACE-inhibitory (ACEI) drugs are commonly used to control arterial blood pressure. Milk fermentation has been shown to be a successful strategy to produce ACEI and/or antihypertensive peptides. In particular, different strains of lactic acid bacteria, such as Lactobacillus helveticus and L. delbrueckii subs. bulgaricus, have been shown to produce fermented milk with high ACEI activity. An example is the production of antihypertensive milk fermented by L. helveticus and Saccharomyces cerevisiae.

The researchers of Spain conducted studies with an aim to select wild strains of bacteria from raw cows’ milk which were able to produce fermented milk with inhibitory ACE activity. A total of 231 microorganisms were isolated from raw cow milk samples and the angiotensin-converting enzyme-inhibitory (ACEI) activity of the resultant
fermented milk produced with the isolated microorganisms was assayed. Forty-six of these microorganisms were selected on the basis of high ACEI activity. Four Enterococcus faecalis strains stood out as producers of fermented milk with potent ACEI activity (IC$_{50}$ 34-59 µg/ml). Single doses (5 ml/kg) of the whey fraction obtained from these fermented milk samples were administered to spontaneously hypertensive rats (SHR) and normotensive Wistar-Kyoto rats (WKY) in order to investigate their possible antihypertensive activity. Highly significant decreases in the systolic blood pressure (SBP) and in the diastolic blood pressure (DBP) were observed when the fermented milk was administered to SHR. Nevertheless, the fermented milk did not modify the SBP and the DBP of the WKY rats. The results suggest that raw cows’ milk is an excellent source of wild lactic acid bacteria able to produce fermented milk with ACE inhibitory activity. Four selected strains of E. faecalis were able to produce pasteurized fermented milk with potent ACEI and antihypertensive activity. Further studies to identify the peptides responsible for these activities are in progress. The study raises the possibility of using E. faecalis strains as starters to obtain functional antihypertensive products. It is also important to point out that the administration of the fermented milk samples did not change the arterial blood pressure of the normotensive WKY rats. The results suggest that the effect of the fermented milk samples is specific to the hypertensive state. Therefore, these products could be used as functional foods without any risk in normotensive subjects [Muguerza B, Ramos M, Sánchez E, Manso MA, Miguel M, Alexandre A, Delgado MA and Recio I, Antihypertensive activity of milk fermented by Enterococcus faecalis strains, Int Dairy J, 2006, 16(1), 61-69].

Proteases from a number of plants including fig (Ficus carica Linn.), cardoon (Cynara cardunculus Linn.), papaya (Carica papaya Linn.), pineapple [Ananas comosus (Linn.) Schult.f.] and castor oil seeds (Ricinus communis Linn.) have been found to coagulate milk. However, their application in cheese making from bovine milk has been largely unsuccessful, mainly because most are found to be excessively proteolytic relative to their milk-clotting activity. Excessive proteolysis can lead to a decrease in cheese yield and defects in the flavour and texture of ripened cheese.

Researchers of Australia examined the milk clotting and proteolytic properties of three plant coagulants, cardoon, ficin and papain, on regular bovine skim milk and ultrafiltered bovine skim milk at different concentrations in comparison with those of calf rennet. The objective was to determine regular and UF milk clotting properties, as well as to measure the extent of casein hydrolysis and proteolysis of regular and ultrafiltered bovine skim milk after clotting, using capillary electrophoresis (CE) and a measurement of free amino acid (FAA) content. This was expected to provide a basis for the application of plant coagulants for cheese making from ultrafiltered bovine milk. Regular and ultrafiltered (UF; 1×, 2× and 4× concentrated) skim milk samples were treated with a range of enzymes including calf rennet, ficin and papain. The clotting properties, curd casein profiles and free amino acid (FAA) contents were determined. In general, UF milk samples coagulated faster and formed firmer curds irrespective of protein concentration. Furthermore, both ficin and papain had a more significant effect on proteolysis in curd formed from regular and 1× UF milk than on 2× or 4× UF milk. Cardoon extract and calf rennet had very similar clotting properties, although the former caused both the capillary electrophoresis profile of caseins and FAA measurements to show slightly more extensive hydrolysis in the curd. The results suggest that the UF process may cause structural changes to proteins or other milk constituents with a resultant change in clotting properties and
The cardoon extract appeared to be slightly more proteolytic than calf rennet, as higher concentrations of free amino acids and peptides were observed in all milk substrates clotted with this coagulant. However, further studies are required to verify whether this can be translated into better quality cheese. Papain was highly proteolytic on both regular and UF milk and gave very irregular clotting performance with different milk substrates. It was, therefore, considered as being unsuitable for cheese making.

Ficin, on the other hand, shows promise as an alternative coagulant but only with milk samples having up to at least four times the regular milk protein concentration. Consequently, like cardoon extract, the application of ficin as a milk coagulant warrants further study [Low Yit Hwei, Agboola Samson, Zhao Jian and Lim Mee Yi, Clotting and proteolytic properties of plant coagulants in regular and ultrafiltered bovine skim milk, *Int Dairy J*, 2006, 16(4), 335-343].

Iron deficiency (ID) is the cause of most forms of anaemia and is considered the major public health problem and the most common nutritional deficiency in the world. To prevent ID, vulnerable populations should be encouraged to consume Fe-rich foods and breast-feed or use Fe-fortified formula for infants. Milk and other dairy products obtained from cows, being rich in calcium, interfere with the absorption of Fe from the diet. However, recent studies have shown that when goat milk (GM) is incorporated into the diet of rats, it produces a greater nutritive use of Fe and minimizes the possible interactions of Fe with other minerals such as Ca, P and Mg, in comparison with animals fed with cow milk (CM). Taking these considerations into account, a study was conducted by researchers of Spain to determine the effects of the particular nutritional characteristics of GM on the digestive and metabolic use of Fe, on haematic parameters and on the distribution of Fe in various target organs of rats with ferropenic anaemia (compared with a control group) to assess the bioavailability of this mineral in comparison with the corresponding effects produced by a diet including CM (the most commonly consumed milk).

Using rats with induced iron (Fe)-deficiency anaemia, this study investigated the effects of diets based on goat milk (GM) or cow milk (CM) lyophilates on the nutritive utilization of Fe, its deposit in target organs and haematic parameters involved in Fe metabolism. GM improved Fe metabolism, especially in Fe-deficient rats, leading to a higher Fe content in the spleen, liver, sternum and femur in comparison with CM. After feeding the rats for 2 weeks with the different diets, the anaemia had decreased, especially with GM, as assessed by higher haemoglobin regeneration efficiency (HRE), serum Fe, red blood cells (RBC) and packed cellular volume (PCV) levels and lower platelet count. The study conclude that dietary GM improves Fe bioavailability in both control and anaemic rats, increasing Fe deposits in target organs and favouring the recovery of haematological parameters after ferropenic nutritional anaemia. The beneficial effects of GM with respect to nutritional ferropenic anaemia, as described in this study, suggest that the inclusion of GM in the diet among the population at large may help in the prevention of the development of Fe-deficiency anaemia, but further investigation in humans is needed [Alférez María JM, López-Aliaga Inmaculada, Nestares Teresa, Díaz-Castro Javier, Barriomeuo Mercedes, Ros Patricia B and Campos Margarita S, Dietary goat milk improves iron bioavailability in rats with induced ferropenic anaemia in comparison with cow milk, *Int Dairy J*, 2006, 16(7), 813-821].