

HEXANAL AS SHELF-LIFE INDICATOR: ACCELERATED STORAGE TEST OF NUTS ANALYSED BY SPME

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Different packaging techniques have been developed to delay oxidation products such as modified atmosphere, oxygen-barrier packaging material and active packaging (oxygen scavengers). The addition of natural or synthetic antioxidants to packaging materials has also been recently investigated.

The present work was carried out to evaluate the effect of different storage conditions of nuts. Nuts were chosen as a model food due to their particular sensitivity to oxidative processes. Grounded nuts were stored under controlled conditions of light and temperature with and without oxygen scavenger.

Hexanal was chosen as the indicator of lipid oxidation and shelf life product degradation.

Oxygen and carbon dioxide were monitored during storage time as well as hexanal content in order to establish a correlation between shelf-life indicator and product oxidation.

Oxygen scavengers were shown to reduce the oxidation, however the analysis of the sachet revealed that other volatile compounds from the headspace were also absorbed.

Keywords: active packaging, oxygen scavenger shelf-life, hexanal

SHELF LIFE OF READY TO USE "CAPRESE"

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"Caprese" salad is a traditional Italian dish and, like 4th range products, it's a "*minimally processed*" and "*ready to use*" food. The ingredients of this dish are tomato and cow or buffalo mozzarella cheese slices, extra-virgin olive oil, basil and wall rocket.

The aim of this work was to evaluate the shelf life of ready to use "caprese", prepared with tomato slices (variety Pachino) and mozzarella cheese, purchased in cheese factory of Apulian area.

Five slices of mozzarella cheese and six slices of tomato of about 10 g of weight were packaged in high barrier plastic bags (Nylon/Polyethylene) and stored at 4° and 15° C.

10 g of mozzarella cheese and tomato were separately diluted with 90 mL of sterile saline solution and blended with a Stomacher Lab Blender for 1 min.

On mozzarella cheese the cell load of psychrotrophic and mesophilic bacteria, lactic acid bacteria, enterococci, coliforms and *Pseudomonadaceae* was carried out; on tomato slices the cell load of lactic acid bacteria, moulds and yeasts was monitored during the storage. pH of mozzarella cheese and tomato homogenates was evaluated, too.

Before opening the plastic bags, the amount of CO₂ and O₂ in the head space was evaluated by a PBI Dansensor.

Experimental cell load data were modeled by the modified Gompertz equation and the derived kinetic parameter of coliforms and *Pseudomonadaceae* were used to calculate the shelf-life of the product. The threshold value was set to 1*10⁵ CFU/g and 5*10⁵ CFU/g for coliforms and *Pseudomonadaceae*, respectively.

Tomato microbial population was mainly composed by lactic acid bacteria; moulds and yeasts, instead, were not detected in our experimental conditions.

Shelf life values at 4° C were 4.36 and 3.00 days for coliforms and *Pseudomonadaceae* of mozzarella cheese.

The CO₂ of the head space increased in all the samples and reached the maximum value (20%) after 12 and 7 days, respectively at 4° C and 15° C, while the amount of O₂ decreased up to the undetectable level.

Because of the microbial activity, pH of mozzarella cheese changed from 6.6 to 5.5 at 15° C; in tomato slices, instead, it was observed a slightly increase of pH value.

Keywords: "caprese", minimally processed foods, shelf-life, coliforms, *Pseudomonadaceae*

EFFECT OF DIFFERENT STORAGE CONDITIONS IN SEMI-INDUSTRIAL TANKS ON THE SHELF-LIFE OF EXTRA VIRGIN OLIVE OIL

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The effect of the use of different temperature and atmosphere during the storage of an extra-virgin olive oil in semi-industrial tanks was investigated during one year. The oil was stoked in three different tanks immediately after the extraction process. Each tank had a capacity of 250 l. Initially all the tanks were filled up completely. Two of the tanks were saturated by nitrogen. Only one of the three tanks was refrigerated. The oils remained in this conditions for three months. After this period the tanks were partially emptied to half in order to simulate the frequently storage condition in the industrial mill plant. The oils remained in this conditions for six months. The oils were sampled every 60 days for the analysis. The analytical parameters considered were: free acidity degree, peroxide value, ultra violet indices (K_{232} , k_{270} , ΔK), total phenol content and induction time. Also the volatile compounds, responsible of the pleasant aroma of extra virgin olive oil, was evaluated by means a PURGE and TRAP system. Our results show the both temperature and atmosphere influence the extra virgin olive oil shelf life in a semi-industrial storage plant.

Keywords: Virgin olive oil, industrial storage conditions, total phenol content, olive oil stability

DIFFERENTIATION OF FRESH SEAFOOD PRODUCTS AND STORAGE TIME USING AN ELECTRONIC NOSE: FEATURES SELECTION FOR DATA ANALYSIS

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Electronic nose devices are becoming a practical tool for the identification of the differences among food products based on their origin, quality and process. Generally, these instruments are based on gas sensors that are not specific for a particular product. Tin oxide gas sensors arrays are those commonly used nowadays. The difficulty in using such instruments is to obtain from the sensors response patterns, useful parameters necessary to identify the differences among samples.

Electronic nose, trimethylamine and pannel test investigation were conducted on samples of three species of Farmed Fish (*Dicentrarchus labrax*, *sparatus aurata* and *Salmo salar*) gutted and sliced into 100g portions. The sliced portions obtained were immediately stored under ice and in abuse temperature of 6 °C and analysed over time. Data from electronic nose were elaborated choosing a series of features (Average of the last 5 points, maximum point, average whole points, and average of interval of the signal maximum variation). A polynomial regression was performed on the different features in order to individuate the contribution of the sensors on the samples response patterns. The data from the best sensors were then used to create an optimum feature (mix features). A principal component analysis was performed on the data of all the features and the degree of separation of the tridimensional scatterplots used as a selective tool. Based on the results obtained, the features "average of the last 5 points" and "mix features" gave a good separation of the samples, "mix features" being the best. The scatterplot from "mix features" data allowed the separation of the fish samples based on species and storage time. The evolution over time of the scores of the PCA accounting for the highest variation of the best two features gave good correlations with trimethylamine content and the overall evaluation of the product by panellists.

Keywords: electronic nose, features selection, fresh seafood, storage time

DETERMINATION OF OIL COLOUR DURING STORAGE: A TOOL FOR A RAPID QUALITY ASSESSMENT

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Spectroscopic techniques are widely employed in the development of methods that enable direct rapid analysis of products without any sample pre-treatment. One of the simplest and widely available spectroscopic techniques is the UV-Vis spectral range. Virgin olive oil is susceptible to oxidation, which has been recognized as the predominant cause of deterioration during storage. The oxidation leads to the degradation of pigments, which are responsible for oil colour, and to the formation of new compounds absorbing in the UV-Vis spectral range and thus contributing to the colour changes. Therefore colour can be a critical tool for oil quality assessment and for monitoring the changes occurring during storage.

The objective of this study was to evaluate the correlations between the colour parameters, measured as ΔE (colour difference between fresh oil sample and the samples stored in different conditions for a certain period of time) and some important analytical indexes measured during storage. Extra virgin olive oil produced from the *Coratina* cultivar at a traditional plant was used for our experimental test. It was stored in different conditions for a period of 12 months. Free fatty acids, peroxide value, UV spectrophotometric characteristics, total phenols, chlorophylls, carotenoids, triglyceride oligopolymers, oxidised triglycerides, and diglycerides were determined for each sample at fixed times (initially and after 1, 2, 4, 6, 10, and 12 months of storage). Colour measurements of the oil were made on a spectrophotometer and colour parameters were calculated in CIELAB system (Commission International d'Eclairage), where L^* indicates lightness, a^* indicates hue on a green to red axis, b^* indicates hue on a blue to yellow axis.

The results obtained from analytical determinations showed that during storage a decrease takes place in the levels of β -carotene and α -tocopherol, characterised by antioxidant activity, together with an increase in oxidative degradation. The oils stored in the light displayed significantly lower carotenoids, tocopherols and chlorophyll contents than the oils kept in the dark. The oils kept in the dark mainly contained products of primary oxidation, while the oils kept in the light contained products of secondary oxidation, as also shown by K_{270} values exceeding the legal limits for extra virgin olive oil. In the end, the oil kept in the light showed significantly higher values of triglyceride oligopolymers.

Concerning the colour measurements it was seen that relatively high regression coefficients were obtained for the correlation between the colour parameters (ΔE) and the chlorophyll concentrations measured during storage. Considerably lower, but in any case significant, regression coefficients were obtained for the carotenoids concentrations, due to their larger stability and considerably lower degradation rates. The correlation between ΔE and K_{270} , the index of secondary oxidation products, produced a very high regression coefficient, which was similar to the coefficient produced from the correlation between colour changes and triglyceride oligopolymers content.

These results prove that instrumental measurement of oil colour directly relates to oil quality and could be used for a rapid quality assessment, and can provide valuable quantitative information concerning the pigment contents of an oil during storage.

Keywords: Extra virgin olive oil; Colour measurement; Oxidative degradation; Storage conditions

SHELF LIFE EVALUATION OF TOMATOES BY THE HS-SPME METHOD

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Flavour, comprised of aroma and taste, is an important food quality attribute. The aroma or odour of a food product is detected when its volatiles enter the nasal passages at the back of the throat and are perceived by receptors of the olfactory system (retro nasal)

The flavour of tomatoes can be characterized by nearly the entire set of their constituents. Indeed, the flavour is not only directly reflected by the sum of the volatile and non-volatile components, but it also depends on their interactions

Solid phase micro-extraction (SPME) headspace sampling combined with gas chromatography (GC), can be used as a reference method for flavour analysis.

Another significant factor for buyers and consumers quality is tomato's colour.

After harvesting, ripening continues and tomatoes can become overripe very quickly. This can result in a loss of quality and a reduced shelf life.

Tomatoes (*Lycopersicon esculentum* Mill.) "loose tomatoes" and "cluster tomatoes" at red ripeness stage were used. During the experiment the shelf life conditions (atmosphere, temperature and relative humidity) were been controlled.

Attributes such as colour, size, shape and external defects of fruit and vegetables are investigated in our study because they tend to determine the choice made by consumers.

In the first experiment, the changes in tomato aroma profiles, dry matter, colour, titrable acidity, sum of sugars and pH of two different cultivars have been monitored at different times.

In the second experiment a short-term anoxia treatment of 24h was applied and the above mentioned parameters were evaluated.

Many compounds undergo important concentration changes during the shelf life of tomatoes. The HS-SPME method is useful to evaluate the above mentioned tomato's changes.

Moreover the short-term anoxia treatment can condition the tomato's rot.

Keywords: tomato, shelf life, SPME, headspace

**SHELF-LIFE OF CHINESE CABBAGE (*BRASSICA CAMPESTRIS* L. ssp. *PEKINENSIS* LOUR)
PACKAGED IN ORDINARY ATMOSPHERE**

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The suitability of four cultivars of Chinese cabbage ('Bilko', 'Kasumi', 'Manoko' e 'Nikko'), different for heart characteristics, to be minimally transformed was evaluated.

To the purpose, immediately after harvesting, cabbage samples were cutted, washed with chlorinated water, packaged under ordinary atmospheric conditions and stored at 4 °C for 8 days.

Samples were analysed at the production day, at the 4th and at the 8th day of storage to determine the physical (color), chemical (dry content, nitrate content, sugars, phenolic content and titratable acidity), anatomic (upper, lower epidermis and mesophyllum thickness, integrity of cell-structures), physiologic (CO₂ and O₂ production), microbiologic (mesophilic viable counts, yeast and moulds, *Enterobacteriaceae*) and enzymatic (poliphenoloxidase activity) parameters.

Results of the study provided information to evaluate, for each cultivar, quality of cut Chinese cabbage during storage.

Appreciable differences were evidenced among cultivars; Manoko exhibited a good phenolic content, the lowest poliphenoloxidase activity, resulting in weak enzymatic browning, and the lowest changes in physical, chemical and physiologic parameters during storage. Concerning microbiological contamination, all cultivars showed a lower number of cfu/g for mesophilic viable counts than the microbiological criteria established by CNERNA-CNRS and generally used for fresh-cut fruit and vegetable until the 8th storage day. Only mould and yeast counts, at the 4th day of storage were higher. However, the results on the whole highlighted the possibility to use successfully Chinese cabbage for the production of minimally processed products.

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Keywords: Chinese cabbage, minimally processed products, quality parameters

CHANGES IN SICILIAN VIRGIN OLIVE OIL DURING STORAGE WITH PARTICULARLY HIGHLIGHTED BIOPHENOL COMPONENTS

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In order to study the changes during storage of virgin olive oils extracted from *Nocellara del Belice*, *Cerasuola* and *Biancolilla* cultivars, homogeneous batches of olive fruits were processed by using different malaxing temperatures. Also, traditional three-phases decanter with different water temperatures was used for oil separation from the solid phase. Oil samples were shared out amber glass bottles and stored in the dark at room temperature.

The changes in turbidity, in lipid substrate, in chlorophyll, carotenoid, total phenol, tocopherol contents and in the phenolic fraction were monitored within the year of olive fruit processing. For each sample the results showed low changes of conventional chemical parameters (acidity, peroxide and UV absorption value), oil turbidity decreased with the lower rate for the olive oil by processing at colder temperature. The evolution of total phenol, tocopherol and hydroxytyrosol derivatives contents showed that the conditions of storage play an important role for oxidative stability of olive oils.

Keywords: sicilian virgin olive oil, storage, biophenol components

EFFECT OF VARIOUS PARAMETERS ON VIRGIN OLIVE OIL STABILITY MEASURED BY RANCIMAT

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The quality of virgin olive oil decreases over the course of time as a consequence of oxidative and hydrolytic degradations.

The present study was carried out to determine the oxidative stability of nine Sicilian virgin olive oils from three cultivars (*Nocellara del Belice*, *Biancolilla* and *Cerasuola*). Acidity content, peroxide value, acidic composition, UV absorption value, colour parameters, chlorophyll, total phenol and tocopherol contents were measured. The oxidative stability calculated by the Rancimat method was correlated with the total phenol content, peroxide value and ratio Oleic acid/ Linoleic acid.

Besides, an investigation on each samples was carried out in order to study the influence that exposure to light, to air and to heat, has on the quality of virgin olive oils during five weeks of storage. Oils exposed to light and to air were stored in transparent and amber glass bottles at room temperature. Samples exposed to heat were kept in the dark at 50 °C. Also, each sample was kept in the dark at room temperature. The observed variations were analysed with statistical method; correlations with initial oxidative stability, measured by Rancimat, were investigated. The results suggested that the shelf life of oils depends on chemical composition and storage conditions.

Keywords: Virgin olive oil, storage, Rancimat test

PACKAGING EFFECTS ON ESSENTIAL OIL CONTENT AND COLOR OF MEDITERRANEAN ORIGIN ORIGANUM VULGARE ECOTYPES

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Volatile compound fraction of essential oil belonging to *Origanum spp.* ecotypes of Mediterranean origin packaged under various storage conditions was assessed. Essential oil composition was evaluated under vacuum and nitrogen modified atmosphere packaging and at different storage temperatures for medium to long term storage. Also, chromatic evolution during storage was performed in order to assess visual changes from fresh product. Ecotypes under trial were characterized by two main chemotypes, performing in a similar way under same storage conditions. Oil content showed a significant decrease for all storage conditions, and remained almost constant between medium and long term storage. Color characteristic changes were instead not very significant, with the exception of luminance values. From the results obtained it appears that the nitrogen modified atmosphere condition can be effectively used for long term preservation of key volatile compounds in *Origanum spp.*

Keywords: oregano, shelf life, MAP, essential oil content

MINIMALLY PROCESSED ORANGE FRUITS: EVALUATION OF PRODUCTS FROM LATE TAROCCO GENOTYPE FRUITS STORED AT LOW TEMPERATURE

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The recent success in the Italian market of Tarocco oranges, due to their excellent sensory and nutritional characteristics, has prompted breeders to select genotypes with high qualitative standards and with early or late maturity period. A clonal selection program, carried out by CRA-Istituto Sperimentale per l'Agrumicoltura, allowed obtaining a late Tarocco genotype named 'Messina', whose fruits can be marketed toward the late spring.

Recent studies on Tarocco fresh-cut oranges have demonstrated that these fruits are suited to being minimally processed. In particular, some examined minimally processed Tarocco clone fruits did not show marked decay phenomena during about 15 storage days.

The aim of our research was to study the possibility of extending the marketing period of these products. For this scope, fruits of a late Tarocco genotype ('Messina') were minimally processed at the harvest time and after 20, 40 and 60 storage days at 6 °C RH 85-90%. The previously selected oranges were washed and disinfected with a solution containing 200 ppm of Cl₂, rinsed with distilled water, dried and manually peeled. Then fruits were sliced along the equatorial axis, using an electric slicer, packaged under normal atmosphere with a film PET+PP by a heat-sealing vacuum/gas machine and stored at 4±1 °C, for about 14-15 days. During the storage period, groups of boxes were sampled every three-four days to determine the microbiological, sensory and physical-chemical parameters.

Microbiological analyses showed that until the 15th storage day, products obtained from fresh fruits and from oranges stored for 60 days had CFU/g values of about 2x10² both for mesophilic viable count and for moulds and yeasts count. Products from Tarocco 'Messina' fruits stored for 20 and 40 days, instead, had higher CFU/g values than the above cited value, but always lower than established by microbiological criteria for minimally processed fruits and vegetables (CNERNA-CNRS, 1996).

With regard to sensory analyses of fresh-cut Tarocco oranges, a parameter, named "sensory acceptability", obtained as follows:

$$\text{Sensory acceptability} = \frac{(F_n + Ar_n + Ac_n + J_n + S_n + Fi_n) - O_n}{(F_0 + Ar_0 + Ac_0 + J_0 + S_0 + Fi_0) - O_0} \times 100$$

where: **F** (freshness), **Ar** (typical citrus aroma), **Ac** (acidity), **J** (juiciness), **S** (sweetness), **Fi** (firmness), **O** (off-flavor), **n** (0, 4, 6, 8, 10, 12, 15 storage days), **0** (slice evaluation at 0 storage day), was determined. A similar behavior for stored and fresh fruits was found. Only a decrease of this parameter of about 20% at the last storage day in all packaged fresh-cut fruits was observed. The physico-chemical results showed that no important changes compromised minimally processed orange nutritional quality. In fact, only a slight reduction in the ascorbic acid content was observed in slices obtained from fruits stored for 40 and 60 days.

Keywords: fresh-cut tarocco oranges, packaging, post-harvest storage

CHANGES IN POLYPHENOL, VITAMIN C CONTENT AND ANTIOXIDANT CAPACITY IN MINIMALLY PROCESSED TAROCCO FRUITS

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In Italy, about 40% of the sweet orange production is represented by a blood cultivar, namely 'Tarocco', whose growing success in domestic and international markets is a result of its exceptional sensorial characteristics, such as the brilliant red flesh color and the distinctive and agreeable fragrance, as well as the large size and the balanced levels of sugar and acids. In addition, these fruits contain high levels of antioxidant compounds including vitamin C, flavanones, hydroxycinnamic acids and anthocyanins. The greater health benefits of blood oranges with respect to blonde oranges and the commercial success of fresh-cut fruits and vegetables have prompted research into the production of ready-to-eat sliced oranges in order to realize a new market segment for blood oranges as alternative fresh fruit consumption. The following work aimed at evaluating the chemical components and antioxidant activity changes during storage of a fresh-cut Tarocco clone with high anthocyanin content ('TDV'). The fruits were minimally processed as slices, packaged in normal atmosphere with three films of different permeability to gas and stored at 4 °C for 14-15 days in order to find the best packaging conditions to maintain antioxidant efficiency and preserve nutritional characteristics of slices. During storage, the antioxidant components profile (anthocyanins, hydroxycinnamic acids, flavanones, total phenols and ascorbic acid) was determined by HPLC and spectrophotometrical methods and juice antioxidant capacity was assessed by means of two different *in vitro* tests (DPPH radical scavenging capacity and inhibition of induced linoleic acid oxidation). The results of chemical analysis showed that, during the 14-15 days of storage, Tarocco 'TDV' slices did not show marked decay phenomena. Only a slight decrease in ascorbic acid content was observed, especially in products packaged with the most O₂ permeable film. Tarocco slices tested in this study showed an evident antioxidant capacity during storage period. Moreover, the least permeable film used for packaging resulted, in both tests employed, the most suitable to maintain the antioxidant efficiency and nutritional characteristics of minimally processed Tarocco 'TDV' oranges.

Keywords: fresh-cut, packaging films, antioxidant activity

EVALUATION OF THE SHELF-LIFE OF ALTAMURA PDO BREAD BY SENSORY AND MECHANIC ANALYSES

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Altamura bread is the first bread having gained a protected denomination of origin (PDO) in European Community. It is obtained from 100% durum wheat re-milled semolina and this, together with the natural leavening process, enables its typical and well known long shelf-life. Usually the shelf-life of bread is monitored by means of the determination of the resistance to compression during time. Nevertheless, the whole sensory properties are essential since they are perceived by the final consumer. Few scientific reports (mainly by the Authors) regard the evaluation of the sensory properties of bread. Furthermore, no paper describes the application of this kind of evaluation to monitor the staling process of bread, while it could be very interesting to verify the extent of the sensory modifications due to staling.

The aim of this work was to evaluate the sensory characteristics (quantitative descriptive analysis) and the mechanic properties (resistance to compression) of Altamura bread during its shelf-life. Regarding the sensory evaluation, a list of descriptors comprising appearance, visual-tactile characteristics, aroma, taste and texture attributes perceived by biting, was considered. The descriptor "overall acceptability" was also evaluated. A set of Altamura breads obtained by a unique bread-making process was stored for a period of time of 6 days and examined at different times during the considered period.

The obtained results indicated that, regarding the mechanic properties, during the whole storage period the resistance to compression increased significantly. As far as the sensory properties are concerned, all the positive characters such as crust crispness, crumb elasticity, and overall aroma decreased while stale aroma, crumb consistency and crumb compactness increased.

In any case, until four days from the production, the examined bread maintained acceptable values for both the sensory characteristics and the resistance to compression. Besides, the "overall acceptability" was still more than sufficient.

Keywords: Altamura bread; Shelf-life; Sensory properties; Mechanic properties; Typical products

VACUUM-PACKAGING OF RIPENED SAUSAGES: ASSESSMENT OF THE SENSORIAL AND CHEMICAL CHARACTERISTICS AND OF THE LIPID FRACTION DEGRADATION

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In order to protect ripened sausages from the oxidative degradation and hence to extend their shelf-life, besides adding natural or artificial anti-oxidant compounds to the paste formulation, vacuum-packaging is also applied to remove oxygen, which is the main cause of food oxidation.

This way of packaging is also useful to avoid the further water loss of ripened sausages. However, the anaerobic storage of sausages under vacuum-packaging may affect the quality characteristics of the product itself. Many studies have revealed a change in the prevailing microflora in vacuum-packed charcuterie products as compared to the microflora prevailing before storage. This microbiologic change could determine some modifications of the sensory properties and affect the nutritional value and the chemical composition of the products. On the other hand, the most of the hand-made sausages are usually stored without any kind of packaging.

Ripened sausages samples, prepared using an industrial processing technology, vacuum-packaged and stored for forty days were examined and compared with ripened sausages obtained by the same processing technology but stored unpacked for the same period of time, in order to determine the influence of vacuum packaging on the sensorial and chemical characteristics and on the degradation of the sausages' lipid fraction,

Regarding to the sensory properties the vacuum-packaged sausages showed, after the considered storage period, significantly lower mean scores of *red intensity* ($p < 0.01$), *global flavour* ($p < 0.05$) and *ripened flavour* ($p < 0.001$), than unpacked ones, thus indicating a smaller overall appreciation by the panellists, while no significant differences were found in relation to the descriptors that are considered defects for this category of products. The level of the oxidative degradation of the lipid fraction of the tested sausages was evaluated by the determination of the triacylglycerol oligopolymers and the oxidised triacylglycerols. The obtained data did not showed significant differences between the two considered ways of storage. The absence of a significant difference between the oxidation level of packaged and unpackaged sausages, even removing oxygen by vacuum procedures and using a low-permeability packaging, might probably be due to the action of the oxygen inside the sausages than by atmospheric oxygen.

No significant differences were found, moreover, between the two storage ways in relation to the sums of saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids and of the trans isomer fatty acids content.

Keywords: Ripened sausages, Vacuum-package, Shelf-life; Lipid degradation, Sensory analysis

DEPENDANCE OF THE SHELF-LIFE OF CARBONATED SOFT DRINKS FROM PET PERFORMANCES AS REQUIRED BY "THE COCA COLA COMPANY"

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PET (Polyethyleneterephthalate) is one of the most important resins used for the package of carbonated water and soft drinks, thanks to the specific characteristics of transparency, lightness, simple transformability, possibility to recycle and gas-barrier properties. Preforms (or parisons) are intermediate products which are manufactured in a wide range of designs and colours by injection moulding. Preforms are then blown with hot air to give the bottle with its final shape and size. The cost of the resin covers a high percentage in the overall cost of the produce, especially due to the recent increments in the price of petroleum, from which PET is derived. As a consequence, according to the numerous standards fixed by "The Coca-Cola Company", Sibeg S.r.l. decided to test a new cheaper PET preform which was suggested by a possible new supplier.

The experiment consisted in the comparison of the main performance characteristics of the old PET bottles with the ones obtained from the new preforms.

"The Coca-Cola Company" requires specific test procedures to authorize a new package. For this reason, Sibeg S.r.l. followed a specific matrix that provides the guidelines, requirements, tools, specification. Among the methods used to test new materials, the gas-barrier properties have a main importance as they are directly linked with the shelf-life of the bottled produces. Shelf-life of carbonated soft drinks is determined by the internal CO₂ level, and limits for this parameter are different for different the types of beverages. Therefore a material with higher CO₂-barrier property would be effective in extending the shelf-life of carbonated drinks. Results evidenced a similar behaviour of the two materials tested for what concerns the characteristics of the bottles (dimensions, appearance, distribution of the material, stress cracking test), showing, in particular, comparable CO₂ internal pressure after 12 weeks of storage.

Keywords: Carbonated soft drinks, gas barrier properties, shelf-life, PET

OFFICIAL CONTROLS OF THE MIGRATION LIMITS IN PRODUCT AND MATERIALS DESTINED TO ENTER IN CONTACT WITH FOOD AND BEVERAGE PERFORMED IN U.S.M.A.F. OFFICE

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In the legislative decree n° 123 3.03.1993 (application of European directive 89/397/CEE) is considered "official control of food products activities, such as inspection, sampling, analysis of the samples, etc. performed by the authority on food products, but also on additives, vitamins, and all those materials and objects made to come in contact with the products already described".

The control activity has to assure the conformity of the different products to guarantee the prevention of any kind of risk for public healthy and to protect consumers interests.

This activity and vigilance are performed by marine, air and customs health offices (USMAF), satellites office of Health Minister. Vigilance of USMAF offices is aimed at vegetarian foods, but also at products destined to enter in contact with food and beverage.

In the last years, an higher number of arrivals of home and kitchen utensils was registered in the Italian harbors, from extra European countries, so that it was useful to intensify controls, and it was decided to organize the Rapid Alert system.

RASFF: Rapid Alert System for Food and Feed is a communitarian rapid alert system to notify in real time direct and indirect risks for public healthy, the RASFF system consents authorities to know immediately if, for a particular product, there was some alert from other offices; in this case goods are sampled and analyzed.

As described in the Reg. 178/2002 art.11, food imported in the community states to enter the European markets should respect all the communitarian laws, according to this rules, industrial managers should ensure effective procedures to deal with any food safety hazard and to enable the complete, rapid recall of any implicated lot of the finished food from the market.

The way to proceed in the sampling follows specific rules according to the substances that we are looking for, in particular heavy metals, according to ministerial decree 5.3.2003 "methods to sample and to analyze maximal limits of lead, cadmium, mercury, 3-MCPD in food products for official controls".

As results from the RASF system data, many utensils destined to come in contact with food and beverage coming from extra-communitarian country, especially from People Republic of China, didn't respect Italian law, according to maximal residual limits of the most common heavy metals.

Keywords: Official control, Italian law, maximal residual limits, heavy metals

FLAVOUR AND SHELF-LIFE OF FRESH SPREADABLE CHEESES

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Fresh cheeses are slow drainage cheeses which usually have subjected to lactic acid fermentation; they are characterized by a moisture content which usually is > 80%; among these, spreadable cheeses are particularly appreciated by consumers for their sensory quality, vs. texture, appearance and flavour. Flavour is one of the most important quality criteria for cheeses; the typical flavour associated with each type of cheese is due to complex biochemical and chemical processes during processing, ripening and storage; these processes lead to a wide range of volatile compounds which contribute to cheese flavour. Study of flavour is useful to define cheese quality, to characterise the cheese, to detect off-flavour but it could be also important to determine the shelf-life of the product. Shelf-life of fresh spreadable cheeses is usually of 1-4 weeks, at refrigeration temperature, depending from the cheese manufacturing and packaging.

The objective of the present study is to verify the variations in volatiles of a fresh spreadable cheese during the storage in order to define an appropriate shelf-life. For this purpose an experimental fresh goat cheese was considered; cheese was made using freeze-dried culture of *Lc. lactis* subsp. *lactis* strain and liquid rennet. Cheese samples, cylindrical shaped, were individually wrapped in parchment paper and then placed inside some little metal containers. Samples were received in our laboratory under refrigerated conditions (4 °C) and analysed immediately upon receipt and during refrigeration up to 21 days. Microbiological and physicochemical analyses have been carried out. Aerobic plate count (APC), psychrotrophic bacterial count (PBC) were performed on plate count agar (Oxoid); yeasts and moulds counts were performed on dichloran-rose-bengal-chloramphenicol agar (Oxoid); lactic acid bacteria (LAB) were grown anaerobically (Gas-Pack anaerobic system, Oxoid) on MRS agar (Oxoid) and aerobically on M17 agar, respectively. The pH of cheese samples was measured with a Hanna pHmeter (Hanna Instr., Padua, Italy); activity water (a_w) was determined by an A.O.A.C. approved method (AquaLab, Decagon Dev., Inc., Washington).

A headspace solid-phase microextraction (HS-SPME) method in combination with gas chromatography-mass spectrometry (GC-MS) has been used for the extraction, identification and quantification of the volatile fraction. Fifty-two volatile components were identified in each analysed sample. Spectral data, linear retention indices and injection of standards were used to confirm the identification; exactly: fatty acids from C₂ to C₁₄ and their ethyl, butyl and hexyl esters, 2-methyl-chetones from C₇ a C₁₀, diacetyl (2,3-butandione); aromatic compounds, aldehydes from C₅ to C₁₀, alcohols, sulphurated compounds, hydrocarbons, lactones and monoterpenes. The identified volatile compounds were mainly free fatty acids; they constituted about the 70% of the total volatile fraction immediately after manufacturing Hexanoic, octanoic and decanoic acids, from the lipolysis of milk fat, together with benzoic acid, from degradation of amino acids, were the main compounds; these substances were essential to the intense aroma of goat cheese. The amount of each free fatty acid increased during the refrigeration at 4 °C; this increase was particularly evident for decanoic, dodecanoic and tetradecanoic acids. The metabolic activity of yeasts and of psychotrophic bacteria could have given a certain contribution to the increasing levels of free fatty acid. Moreover, differences have been evidenced for each class of substances identified. For instances, monoterpenes and sesquiterpens decreased during storage and they could give significant information on the freshness of the cheese. Altogether considered, the differences observed in the volatile fraction up to 15 days of refrigeration were not particularly evident; thus, a shelf life of 15 days resulted appropriate for this type of cheese.

Keywords: Shelf-life, flavour changes, fresh spreadable cheeses, SPME/GC-MS

INVESTIGATION ABOUT PICHIA ANOMALA KILLER TOXIN AND ITS EFFECTIVENESS AS ANTIMICROBIAL IN PAPER PACKAGING MATERIALS

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Natural antimicrobial substances are attracting increasing attention due to their low impact on human health and high effectiveness on target species. There is, moreover, mounting consumer bias against chemical preservatives: the usage of bio preservatives complies with the consumers' demand for "clean and green" products.

Research on killer yeasts for industrial application is relatively new. These yeasts are able to produce proteinaceous toxins displaying antimicrobial activity against a broad range of food spoilage microorganisms.

We have focused our attention on *Pichia anomala* killer toxin on the basis of literature data that demonstrate its high activity against yeasts and fungi. The toxin was produced by culturing *Pichia anomala* DBVPG 3003 on rich liquid media (YPD) at 25°C. The cultural broth, containing the toxin of interest, was subjected to concentration and preliminary purification by means of ultrafiltration membranes.

Semi-purified toxin preparations were adsorbed on samples of paper packaging materials. The papers chosen have different characteristics (bleached/unbleached, transparent/opaque, grease-proof, calandered etc.) and are commonly used as packaging materials for a wide range of foods. Antimicrobial activity of the toxin-treated materials was evaluated by measuring inhibition of microbial growth within agarised cultural media. *Brettanomyces bruxellensis* was chosen as test microorganism for the measurement of antimicrobial activity.

Keywords: Antimicrobial activity, paper packaging materials

THE TRACEABILITY AND LABELLING OF GENETICALLY MODIFIED ORGANISMS (OGM) IN THE EUROPEAN UNION

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Alimentary safety represents a topic of primary importance within the framework of processes of deregulating markets, with effects of important concern, in addition to consumer protection, also with regard to respecting the rules of competition and the safeguarding of local identities.

In the course of the last years, the European Union has defined a specific policy of interventions in this field, having established the principles and general requirements of alimentary legislation through the issuing of numerous provisions. These have led, in 2002, to the institution of the European Authority for alimentary safety.

The present contribution intends examining the measures launched by the EU concerning the traceability and labelling of products obtained by OGM. It intends, in particular, to highlight, with regard to the legislative context of reference, the modalities through which the creation of an "emergency net" is planned to cover all the stages along which the product is developed, from production to marketing, up to the presentation and labelling of the end product, in respect of the consumer's right for information.

INFLUENCE OF THE EXPANSION DEGREE ON THE SHELF LIFE OF HOT-AIR-PUFFED AMARANTH SEEDS

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Puffed amaranth seed is commonly used in South American Countries as a breakfast cereal, as an ingredient in nutritional beverages and in a traditional snack called *alegría*. Amaranth seeds contain 15-22% proteins rich in lysine, 58-66% starch, 9-16 dietary fibres and 6-8% lipids with a high degree of unsaturation (linoleic acid represent more than 50% of total fatty acids). The aim of the present study was to evaluate the effect of the expansion degree of the seeds on the enzymatic and non-enzymatic oxidation of the amaranth oil, after two months storage at 25 °C. Amaranth seeds were puffed (9 different experiments) with hot air at a temperature ranging between 270 °C and 312 °C. After puffing, the products of each trial were classified in three groups for dimensions (class A: mean diameter of 1.95 mm; Class B: 1.56 mm; class C: 1.17 mm.) and evaluated for moisture, water activity, bulk density, starch damage, peroxide number, lipase and lipoxygenase activity. The puffing process, as evidenced by the SEM analysis, radically changed the original grain organization leading to a very porous and highly disorganized structure. Seeds of class A presented a lower moisture content, a higher degree of starch damage, as evidenced by the viscoamylographic and by the enzymatic analyses, and a high peroxides content. On the contrary, the level of lipase inactivation was similar in the different samples while lipoxygenase was completely inactivated by the puffing process. When observed by SEM, the surface of the less expanded products (class C) appeared partially protected against oxygen uptake by the presence of teguments still stuck to the endosperm. Statistical evaluation of the data evidenced that lipid oxidation was solely related to the degree of expansion independently of the puffing temperature. Therefore the possibility of increasing the shelf-life of puffed amaranth should mainly depend on oxygen removal from the package atmosphere.

Keywords: amaranth, puffing process, lipid stability

SHELF LIFE DETERMINATION OF THREE KOREAN SAVOURY SAUCES**JUNG HYUN YUN AND DONG SUN LEE**

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A variety of savoury sauces are used in Korean homes and food service to enhance palatability and satisfaction of Korean foods. Various combinations of preservation hurdles are being used to keep the products stable for extended period of time. The product characteristics affect the storage stability and shelf life. Primary quality attribute limiting the shelf life depends on the product composition and property. Three typical savoury sauces used with Korean foods were submitted to storage test to provide general picture of their shelf life behaviour. The tested products include a liquid sauce of meat extract for cold-immersing noodle, soybean paste seasoning for cooked rice and semi-liquid sauce for sandwich bread. The liquid meat extract sauce for noodle processed and packaged with hot fill shows absence of aerobic bacteria and has a little low pH of 4.3 and high water activity of 0.98. Soybean paste seasoning for cooked rice having low pH of 4.0 and low water activity of 0.78 has initially some microbial load of 2.8 in log CFU/g coming from fermented soybean paste ingredient. The semi-liquid sauce for bread has low initial pH of 4.0 and intermediate water activity of 0.88. All the product packages stored at 5, 15, 25 and 35°C were taken out periodically to measure the quality attributes including pH, water activity, microbial growth and lipid oxidation degree.

For liquid meat extract sauce the primary quality change determining shelf life was found to be lipid oxidation measured in thiobarbituric acid value, while those for soybean paste seasoning and semi-liquid sauce for bread were pH decrease and colour change, respectively. Water loss was significant for flexible pouch package of liquid meat extract sauce, and there was some noticeable increase in microbial count of soybean paste seasoning for rice. Some pH decreases were also observed for liquid meat extract sauce for noodle and semi-liquid sauce for bread. The temperature dependence of the primary quality attributes could be described by Arrhenius equation to give the shelf life estimation as function of temperature. The activation energies for liquid meat extract sauce, soybean paste seasoning and semi-liquid bread sauce were 20.3, 28.0 and 53.7 kJ/mol.

Keywords: Savoury sauce, storage stability, shelf-life, primary quality index, temperature effect

Note

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