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# Potential Assessment of Prospective Application Of Clean Development Mechanisms Concerning Brazilian Food And Beverage Industries

C. E. L. de Oliveira\*, B. M. Araújo G. Tommaso and J. A. Rabi

Faculty of Animal Science and Food Engineering (FZEA) - University of São Paulo (USP)  
Av. Duque de Caxias Norte, 225, Pirassununga, SP, 13635-900, Brazil

\* Corresponding author. Email: celsooli@usp.br, Tel: +55-19-3565.4290, Fax: +55-19-3565.4284

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**Abstract.** *This work aims at discussing the potential exploitation of Clean Development Mechanism (CDM) by Brazilian food and beverage industry. It is suggested that such industrial sector is able to considerably expand its energy savings, to improve its residues treatment and to reduce its emission of greenhouse effect gases. By evoking official data (e.g. Brazilian Energy Balance Report and Brazilian Initial Communication to United Nations Conference on Climate Change), the present analysis demonstrates that Brazilian food and beverage industry is positively able to enhance its participation at proposed CDM projects and thus contribute to greenhouse effect mitigation. Based on presented data and as far as the food and beverage industrial sector is concerned, one may realize that (i) it has a high potential for energy saving, (ii) it possesses considerable sources of biomass, (iii) it is able to reduce its emissions to a large extent and (iv) it may improve its residue treatment. Bearing in mind GHG emission, liquid effluents and biomass availability, one then verifies that levels related to food and beverage industry are higher when compared to corresponding counterparts related to any other industrial sector. This fact suggests that the food and beverage sector has a considerable potential to implement sustainable development projects, thus helping to reduce pollutant emission to the environment.*

**Keywords.** *Clean Development Mechanism, energy saving, cogeneration.*

## **Introduction**

In view of the Climate Convention signature, several countries have been targeting common goals so as to avoid accelerated atmospheric changes due to human interference. Among the anthropic events over the environment, greenhouse effect increase is a matter that has astonished the international community.

Aiming at reducing the emission of greenhouse gases (GHG), Kyoto Protocol has proposed that emissions by years 2008-2012 should be on average 5% lower than the levels verified in 1990. Among the means proposed to fulfill such objective one may point to emission trade involving industrialized countries, joint completion of mitigating actions and the so-called Clean Development Mechanisms (CDM) to be accomplished by countries included in Annex 1 of the Climate Convention together with non Annex 1 countries.

Based on decisions number 17 and number 19 from Marrakech Agreement and subsequent meetings, CDM projects are always categorized into one of the following models:

- Energy saving enhancement;
- Enhancement of sinks / reservoirs for GHG through reforestation and forestation;
- Use of renewable energy sources;
- Emission reduction / limitation at transport areas;
- Residue treatment.

For a CDM project to be considered consistent and to be approved, the following issues should be observed:

- It must be voluntary;
- It should yield measurable and long-term benefits;
- It should bring about additionality (defined as the difference between GHG emission before and after the implementation of the CDM project);
- It must introduce sustainable development.

Bearing in mind the models proposed by the Marrakech Agreement, one might recognize that certain industrial sectors are particularly keen to reduce their emissions. Energy intensive sectors like siderurgy, metallurgy and mining could also claim for special attention. On the other hand, due to its particular production chain based on the demanding use of biomass, there are sectors showing interesting emission features such as food and beverage industries.

For such industries, article 12 of Kyoto Protocol grants the viability of CDM projects. Their application has in turn opened a new horizon for research and technology and it may provide sustainability to food and beverage production, which is of great importance to the Brazilian gross product. Accordingly, the present paper intends to assess the potential for CDM application by Brazilian food and beverage industries.

## **Method**

Under the light of CDM project execution, this paper discusses the scenario of Brazilian food and beverage industry based on data extracted from IBGE (2004), ABIA (2006), CETESB (2006), Brazilian Energy Balance Report (MME, 2006), Brazilian Initial Communication to the

United Nations Conference on Climate Change MCT (2004) and papers related to the issue (Cunha, Walter & Rei, 2006). Data analyzed include both GHG and effluent emission from food and beverage industries so as to assess the definite potential to apply either energy saving or residue treatment projects and their resultant CDM application.

## **Results**

According to ABIA (2006), since 2000 the food industry has experienced an annual growth ranging from 9.2% to 10.1%, thus keeping a quite fast increase rhythm, even higher than Brazil's gross product evolution. Based on data from MCT (2004), food and beverage industry is the second largest CO<sub>2</sub> emitter (629,000 tons from 1990 to 1994) among all industrial sub-sectors. Such emissions can be divided into three groups:

- emissions related to energy consumption;
- industrial emissions;
- emissions due to utilization of solvents and other chemical products.

### ***Energy consumption***

Many food and beverage industries generate some sort of biomass as residue, which can be directly employed as boiler fuel (for energy cogeneration) or might undergo anaerobic treatment for methane production to be used as fuels, as suggested by MEE (2006). Of particular interest, there is a large contribution of biomass as wood or sugarcane bagasse to the final energy consumption. Therefore, the food and beverage industry has a relatively smaller dependence on fossil fuels.

Kyoto Protocol states that biomass fuel data should be included into the national total energy and CO<sub>2</sub> emission accounting inasmuch as biomass is able to recover free carbon, as based on IPCC (1997). For this reason, a significant opportunity comes forward to the food and beverage industry in order to accomplish sustainable development projects if one considers a larger share for natural gas in the Brazilian energy matrix. In fact, such idea is the underlying rationale of the base line related to a recognized CDM project presented to CQNUMC by Brazilian companies (Leme, Cunha, Walter, 2006)

A successful example concerning energy cogeneration from biomass occurs at the sugar-alcohol industry as sugarcane bagasse is utilized to produce electricity and process steam. With respect to energy, biomass fuels were regarded major CH<sub>4</sub> emitters in 1994 (94%), when sugarcane bagasse was the third largest emitter (6.5% of total emissions) and the solely fuel type to show an emission augment. For the analyzed period, CH<sub>4</sub> has indeed experienced a quite high growth rate (41%) (ABIA, 2006), if one looks at the food and beverage industry, a sector that includes the sugar-alcohol industry. As bagasse-based cogeneration can yield certified carbon credits, in accordance to an existing approved methodology, alternative biomass exploitation (e.g. rice husk) should be consistently considered.

In line with IBGE (2004), many food and beverage industries are ranked as medium energy-intensive. In spite of that, a strong reason to invest on sustainable development projects in this sector has to do with its high potential for energy saving projects, as shown in Figure 3 as it is observed that its energy expenses to yield US\$1000 are far larger than the average expense assessed for other industries. Concerning energy consumption, PROCEL studies point up to a 10% reduction potential by simply improving industrial process efficiency.

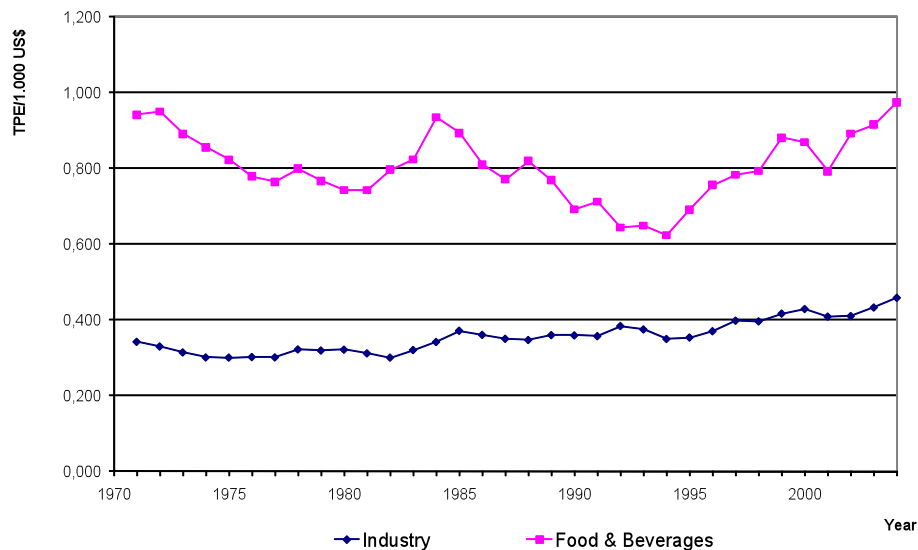


Figure 3: Comparing gross product yield in the food and beverage industry to other industrial sectors.

### **Residue treatment**

Data from CETESB (2006) for Sao Paulo state show that food and beverage sector was responsible for 79% of all effluent emissions. On the other hand, data for 11 Brazilian states show that such sector contributes with 58.5% to overall effluent emissions. The wastewater generated by the food industry is derived directly from the processes occurring in the facility, washing the facilities and equipment, storage areas, industrial restaurants and sanitary sewage. Normally, this wastewater has high levels of organic biodegradable matter. Surrounded by the commonly used biological processes, anaerobic digestion is considered the best option for the treatment of effluents with high concentrations of organic matter and according to Field (2002) the food and beverage industries are the first and second among the four top applications of high rate anaerobic reactor systems. According to Kassam, Yerushalmi & Guiot (2003), about 26% of the anaerobic reactors installed in North America are used for the treatment of effluents from breweries. Leal, Chacin, Behling, Gutierrez E, Fernandez N. & Forster (1998) found removal efficiency of organic matter (expressed in chemical oxygen demand – COD) of 96% using an anaerobic filter of 5.8 m<sup>3</sup>, operated at room temperature with the organic loading rate of 8 kg COD.m<sup>-3</sup>.d<sup>-1</sup>, treating brewery wastewater. The use of anaerobic filters requires careful removal of suspended solids to avoid clogging of the effluent and, consequently, the formation of short circuits or preferential pathways. Ahn, Min, & Speece. (2001), using a Up flow anaerobic sludge blanket (UASB) reactor to treat wastewater brewery, found efficiencies of 90 ± 3% of COD removal, operating under organic loading of 25 kg DQO.m<sup>-3</sup> of sludge.day<sup>-1</sup>. Uzal, Gökçay, & Demirer (2003) studied a two-stage UASB reactor and concluded that this configuration was very effective for the treatment of wastewater from the production of whiskey, even with high organic loads (39 kg-DQO.m<sup>-3</sup>.Day<sup>-1</sup>). The use of effluent recirculation combined with taller reactors (or a high height/diameter ratio), resulted in the expanded granular sludge bed (EGSB) reactor (Seghezzeo, Zeeman, van Lier, Hamelers, & Lettinga, 1998), an efficient option to treat food and beverage wastewaters. EGSB could efficiently treat palm oil mill effluent at maximum OLR of 5.8 gVS/(L-reactor.d) with more than 90% COD removal and methane yield of 438 ml-CH<sub>4</sub>/gVS- added (Fang, O-Thong, Boe & Angelidaki, 2011). Another option for the treatment of wastewater in the food and beverage industry is the anaerobic sequencing batch reactor (ASBR), which according Moletta (2005), is a very

promising technology for wineries. The treatment of cheese whey was also tested by Ratusznei, Rodrigues, Camargo, & Zaiat (2003) using an ASBR, with biomass immobilized on PUF matrices. The reactor was fed with dehydrated reconstituted cheese whey with rising COD concentration, varying from 500 to 4000 mg COD .l-1. Using 8 h of cycle time and 200 rpm (mechanical stirring, at 30°C), the global efficiency of the system was always higher than 96% (COD removal). Finally it seems important to comment about the anaerobic baffled reactor (ABR), which according to Barber & Stuckey (1999) promise for industrial wastewater treatment since it can withstand severe hydraulic and organic shock loads, intermittent feeding, temperature changes, and tolerate certain toxic materials due to its inherent two-phase behavior. Besides treatment of the effluent, the anaerobic reactors have the characteristic of producing biogas. It is possible to use biogas as a natural gas substitute and for steam-reforming. Prior to any kind of utilization, there are three compounds that must be removed, water, CO<sub>2</sub> and H<sub>2</sub>S which is also present in biogas being toxic presenting corrosive effects. So for a reasonable utilization of biogas as an alternative energy source, its purification is more than required, it is compulsory.

### ***Solvent utilization***

The first Brazilian counting of GHG anthropic emissions cites the emissions from food industries due to solvent utilization in two situations:

- During cereal and fruit fermentation process, there are emissions of the so-called non methanic volatile organic compounds (NMVOC);
- During vegetable oil extraction, which is a process using solvents to extract those oils from seeds and grains.

In both instances, Brazilian production related to such sector has increased significantly, despite they are commodities strongly influenced by international market. For the first case, foreseen emissions are associated to alcoholic beverage production and process improvement might be implemented in order to enhance both process efficiency and control over gas escape.

For the other case, the aforesaid report claims that it is reasonable to suppose that emissions depend upon on factors like plant age, emission control efficiency and the sort of processed seed / grain (yet, such report does not make reference to any literature that defines criteria or conditions to assess such emission factors). Bearing in mind that Brazil possesses a modern soy processing industry, along with its corresponding technology and exportation sector, the lower range has been opted, namely 0.85 kg-VOC/ton of crushed seed or grain. However, Brazilian grain production (particularly soy) tends to keep its increasing pace, which demonstrates that such sector is continuously concerned with technology innovation so as to avoid emission excess.

### **Conclusions**

Based on presented data, it is possible to arrive to the following conclusions concerning the food and beverage industrial sector: (i) It has a quite high potential for energy saving; (ii) It possesses considerable sources of biomass; (iii) It is able to reduce its emissions to a large extent; (iv) It can likely improve its residue treatment using Anaerobic Digestion technologies. By comparing the levels related to GHG emission, liquid effluents and biomass availability one verifies that levels related to food and beverage industry are higher than their corresponding counterparts related to any other industrial sector. This fact suggests that the food and beverage sector has a considerable high capacity to implement sustainable development projects and thus help reducing pollutant emission to the environment

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## Postharvest Food Losses and Wastage: Quantification and Impacts on Food and Nutrition Security

Umezuruike Linus Opara\*

South African Research Chair in Postharvest Technology, Department of Horticultural Science, Faculty of AgriSciences, University of Stellenbosch, Stellenbosch 7600, South Africa. \*Email: [opara@sun.ac.za](mailto:opara@sun.ac.za); ph: +27-21-808-4064; fax: +27-21-808-3743.

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Contact person. [opara@sun.ac.za](mailto:opara@sun.ac.za)

**Abstract.** *The recent global food price crises coupled with rapidly declining natural resources, climate change and public demand for sustainable and ecological production practices have raised new concerns about the impact of current agriculture and food production systems which rely on input intensification. Despite considerable advances in increasing plant and animal food production and technological innovation in postharvest handling and processing that contributed to avert widespread global hunger and malnutrition, the challenges of food and nutritional security continue to prevail, particularly in parts of Africa and Asia. Given the resource limitations and the environmental ecological costs of increasing food, feed and fibre production through the expansion of agricultural land, the preservation and conservation of harvested food and raw materials must be part of the global solution towards sustainable food and nutrition security. High incidence of postharvest food losses is one of the major limitations to achievement of sustainable food and nutrition security through the impacts of reducing food availability and loss of opportunities for employment and income generation. To reduce losses, accurate and reliable data are required on the incidence, magnitude and nature of losses so that appropriate economic policies and cost-effective technologies can be deployed at relevant links in the value chain. Extensive review of global literature showed that available food loss estimates are dominated by old data collected through expert knowledge, questionnaires and field studies on selected links in the supply chain. Current estimates on the magnitude of postharvest food losses vary considerable for the same geographical area, crop and handling system. Overall, loss estimates are higher in developing and emerging economies but higher level of losses occur downstream (retail and household) in developed countries. On a global scale, it is estimated that up to 50% of total food production may be lost due mainly to the lack of appropriate postharvest handling, preservation and processing technologies. Given that over 1 billion people are affected by food and nutrition insecurity, reducing the high level of food loss and waste and adding value which create opportunity for new postharvest handling and processing business represents a sustainable approach to enhancing food availability and reducing poverty. The magnitude of losses will be discussed based on data on a wide range of food types and regions..*

**Keywords.** Postharvest loss, food loss, food wastage, food and nutrition security, cold chain, food preservation, food packaging, food quality, food safety, environmental impact, sustainability

# Potential Application of Salicylic Acid Treatments on Postharvest Horticultural Products

Han T. Li L.-P. \* Zhang, H.-Y.

School of Food Science, Beijing University of Agriculture, Beijing 102206, China, phone & fax:86-10-80799170, E-mail: [taolhan@yahoo.com.cn](mailto:taolhan@yahoo.com.cn) and [midnight760828@sina.com](mailto:midnight760828@sina.com);

\*Beijing Key Laboratory of Plant Resources Research and Development, Beijing Technology & Business University, Beijing 100037, China, phone & fax:86-10-83656098, E-mail: [llpopopo@yahoo.com.cn](mailto:llpopopo@yahoo.com.cn)

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**Abstract.** *The effects of salicylic acid (SA) treatments on physiological and quality parameters of postharvest horticultural products, including flowers, fruits and vegetables, were reviewed. The applications of SA extended shelf time of fresh cut flowers, which were Oncidium flowers, cut rose, yellow cut Chrysanthemum, etc. The mechanism included that exogenous SA alleviated respiration, increased corolla diameter, improved water absorbing, maintained flower water balance. SA performed some effects on the controlling post-harvest diseases caused by Colletotrichum musae, Aspergillus niger or Curvularia lunata in banana, Botrytis cinerea in kiwifruit, Physalospora in apple. SA gave the better maintenances of fruit quality, i.e. decreasing loss of flesh firmness in apple, banana, peach, pear, persimmon, tomato, as well as decreasing the losses of titratable acid, soluble solids or ascorbic acid in loquat, pear, tomato, etc. The respiration of fruits was inhibited by exogenous SA in apple, mango, or peach, and the peak of ethylene production in peach was delayed. The active oxygen metabolism in fruits was also affected by SA treatments. The activities of superoxide dismutase (SOD) and catalase (CAT) were increased or the contents of H<sub>2</sub>O<sub>2</sub> and malondialdehyde (MDA) were decreased by SA in banana and loquat. The lignification and its related enzymes activities in loquat fruit, including the activities of phenylalanine ammonia lyase (PAL), polyphenol oxidase (PPO), cinnamyl alcohol dehydrogenase (CAD) and peroxidase (POD), were inhibited by SA. The effects of SA in various fruits were dependent of its concentrations applied. Fruit injuries were observed by extra SA in banana, mango, and peach. In a whole SA was of potential in the application of postharvest horticulture products, and more investigations were needed for the applied concentration and combination with other techniques.*

**Keywords.** salicylic acid, postharvest, fruits, vegetables, cut flowers.

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## Introduction

Salicylic Acid (SA) , o-hydroxybenzoic acid, is one of phenolics chemicals produced from metabolism in plants. Salicylates appear naturally in most of fruits and vegetables consumed for human being (Perry, Dwyer, Gelfand, Couris, & McCloskey, 1996). Scheier (2001) advanced that salicylic acid ought to be one of reasons to eat fruits and vegetables.

Many important functions of salicylic acid in plants have been discovered since the 1960's. These included inducing disease-resistance in some plants, inducing development of flower, and inhibition of ethylene biosynthesis in pear cell suspension (Raskin, 1992). Since the 1980's, SA has been applied for rot control of bananas (Ram and Vir, 1984), and oranges and potatoes (Gaur and Chenulu, 1982). The relationship between salicylic acid and disease resistance in plants has been explored extensively (Dempsey, Shah, & Klessig, 1999; Shah, 2003).

Of the results, the fact that interested postharvest researchers is the SA inhibition of ethylene biosynthesis in pear cell suspension cultures (Leslie and Romani, 1986, 1988) and in other tissues (Romani, Hess, & Leslie, 1989). Raskin, (1992) suggested that SA qualified as a plant hormone. Investigations were got to focus on roles of SA in postharvest horticultural products, including qualify as well as physiology basis since the late of 1990's. The influence of salicylic acid treatment on postharvest horticultural products (Han, Li, Wang, & Feng, 2002) was reviewed. Progress had been made on the quality effects and their physiological mechanism of horticultural products with salicylic acid treatment in the past decade. This review will focus on the works of SA application on horticultural products in the past decade or early a bit.

## 1 Effects of SA application on fresh cut flowers

Hew (1987) observed the good effect of acetylsalicylic acid (10-100 mg/L) on bud opening of *Oncidium* flowers at 20°C. It supplied another preserver of cut flower for replacing the environment-pollution or expensive ones.

SA treatment (50 mg/L), compared with deionized water, significantly decreased the respiration rate, alleviated the moisture stress and the membrane injure, improved the decorative quality of cut flower rose in vasing duration and lengthened the holding-vase life for 3 days. The effect was similar to that of 8-hydroxy quinoline citrate (8-HQC), but more colorful and ornamental. For cv. Samantha SA treatment (25 mg/L) decreased the contents of MDA and free proline, and delayed water stress and senescence. The Aspirin at 25 mg/L decreased the damage of flower membrane, delayed the etiolating of lamina and the disappearance of chlorophyll of leaves, improved the decorative quality of the vase period of cut rose (cv.Karolinal) as a whole.

Yellow cut *Chrysanthemum* were applied for SA at 60-80 mg/L, and held at 16-24 °C. The shelf time with SA at 60 mg/L was 12 days, extended 5 or 2 days compared to distilled water (control) or AgNO<sub>3</sub> (reference), respectively. The fresh weight, water balance as well as corolla diameter of the product were maintained better at the SA concentration. A similar result was obtained from carnation (*Dianthus caryophyllus*), in which the proper SA concentration was at 25 mg/L.

## 2 Effects of SA applications on postharvest fruits

### 2.1 Controlling of postharvest diseases in fruits and vegetables by SA

Post-harvest diseases of fruits and vegetables are the limiting factor on the shelf life and storage period for products. SA performed some effects on the controlling post-harvest diseases

caused by *Colletotrichum musae*, *Aspergillus niger* or *Curvularia lunata* in banana (Ram and Vir, 1983, 1984, 1986), *Botrytis cinerea* in kiwifruit (Poole and McLeod, 1994), *Physalospora* in apple (Yuan, 1996).

Yan, Shen, & Liu (1998) observed that 0.1% SA treatment on green mature tomato, apple, and pear increased disease-free fruits by 10% at least than those of the control stored at room temperatures. The rot of peach during storage was eliminated by 0.01%-0.03% SA treatment (Li and Han, 1999). The decay rate of orange at 3 months storage was about 15% that of control (Zhang, Zheng, Wei, Liu, & Xie, 2000). The 0.5g/L and 1.0g/L SA treatments effectively inhibited the decay development of the black spot disease (*Alternaria alternata*) of Pingguoli pear (*Pyrus bretschneideri* Rehd.), which were more significant at cold storage than at room storage. Pre-harvest treatments with 2mM SA significantly reduced lesion diameters on sweet cherry fruit caused by *Monilinia fructicola* compared with control of post-harvest treatments, induced beta-1,3-glucanase, phenylalanine ammonia-lyase (PAL) and peroxidase (POD) activities during the early storage time (Yao and Tian, 2005). The possible reason of inhibited ring rot in apple by SA treatment might come from inducing the expression of the resistance gene.

It was established that the increased resistance of the products might be related to the induced diseases resistance (Dempsey et al., 1999; Yu, Cen, Li, & Fu, 1999; Halim, Vess, Scheel, & Rosahl, 2006). It was found that SA could induce PAL mRNA accumulation and as a result, enhance PAL protein amounts and activity as well as the accumulation of phenylpropanoids such as phenolic acids, PAL is a key enzyme in phenylpropanoid metabolism, perform defense-related functions within plants (Chen, Wen, Kong, Pan, Zhan, & Li, 2006). Induction of multiple stress tolerance in plants by exogenous application of SA and its derivatives may have a significant practical application in agriculture, horticulture and forestry (Senaratna, Touchell, Bunn, & Dixon, 2000).

## **2.2 Improvement of fruits and vegetables quality and its physiological basis**

Improvement of product quality is one of the most important factors for application of new technology.

Apple (cv. Guoguang) , treated by g/L SA during 30 days storage at 12-18 °C, showed the higher soluble solids content (SSC) or ratio of SSC to titratable acid content, and lower respiration rate of fruits than those of control (Han and Li, 1997). The production of ethylene was obviously inhibited (Yuan, 1996; Fan and He, 1998).

The firmness of peach (cv. Okuba) treated by SA at 0.1-0.3 g/L was higher than that of untreated fruit during early 4-5 days at room temperatures as well as during 20 days at 8-10 °C (Li and Han, 1999, 2000a) . SA treatment inhibited the respiration rate and delayed the ethylene production peak of stored peaches at room temperatures (Han, Wang, Li, & Ge, 2003), increased superoxide dismutase (SOD) activity at 10 °C (Han and Li, 2000) and decreased lipoxygenase (LOX) activity at 22-25 °C or 0-2 °C (Zhang, Han, Wang, Li, & Yu, 2005).

The SA at 0.3 g/L for 20 min decreased the rot or weight loss of stored Valencia orange (cv. Olinda) fruits, and maintained the higher contents of total soluble solids, titratable acid and vitamin C. In *Citrus Sinensis* (L).Osbeck cv.Washington Sangnina the SA at 1.0 g/L for 30 min enhanced the total soluble solids content or firmness of the fruits, and delayed the reducing of activities of SOD or catalase (CAT) , restrained the increasing of LOX activity or MDA content.

The SA treatment at 0.1 g/L for 20 min inhibited the rot of stored pear (cv. Huanghua) at 26-30 °C, decreased the loss of fruit firmness and titratable acid, maintained higher contents of total soluble solids and vitamin C, inhibited the decline in SOD, CAT and peroxidase (POD) activities and decreased the cell membrane leakage and MDA accumulation. Tree spraying of SA 0.02

mmol/L increased the fruit rigidity and titratable acid content, inhibited the activities of POD, polyphenol oxidase (PPO), phenylalanine ammonia lyase (PAL) in postharvest fruits, which was benefit for the storage of pears (cv. Korla xiangli).

The softening and rot are main problems in storage of banana fruits. The SA at 0.5 mmol/L for 6 hrs maintained pulp firmness, decreased the ratio of pulp to peel, delayed the degradation of starch as well as accumulation of total soluble sugar of stored fruits (cv. Baxi) at 25 °C. Fruit softening, pulp: peel ratio, reducing sugar content, invertase and respiration rate have been found to decrease in SA fruits as compared with control ones, and the activities of major cell wall degrading enzymes, viz. cellulase, polygalacturonase and xylanase were found to be decreased in presence of SA, the major enzymatic antioxidants CAT and POD were also found to be **decreased** in presence of SA during banana fruit ripening Vc (Srivastava & Dwivedi, 2000). Hu et al. (2009) observed the reducing of degradation of starch to soluble sugar in pulp of fruits (cv. Pubeiaijiao) as well. They also found that SA at 0.8 mmol/L for 4 hrs significantly increased the activities of SOD, CAT or POD, and decreased contents of H<sub>2</sub>O<sub>2</sub> or MDA.

Loquat (*Eriobotrya japonica*, cv. Dawuxing) fruits were soaked in 0.1 g/L SA solution, and then stored at 4-8 °C. The fruit rot, weight loss rate were reduced, and higher contents of titratable acid, soluble solids and vitamin C were maintained. The measurement of parameters on active oxygen metabolism of the fruits indicated that SA treatment could obviously increase SOD and CAT activities and inhibited POD activity as well as MDA content, the senescence of the fruits was delayed. Flesh leatheriness is the dominating factor that destroys edible and commercial values of loquat. The fruits (cv. Jiefangzhong) were immersed in 1.0 g/L SA solution for 20 min before storage at 4 °C, their activities of PAL, PPO, cinnamyl alcohol dehydrogenase (CAD), and POD were inhibited and lignin content or fruit firmness decreased, which suggested that SA treatment could inhibit lignifications of loquat during cold storage (Wu, Chen, Tang, & Xia, 2006).

The SA at 0.1-0.3 g/L showed the efficiency of delaying the decreasing of flesh firmness in persimmon (*Diospyros kaki* cv. Mopan) (Li and Han, 2000b). The peel-color changes of mango at 13°C or tomato at 20°C were delayed by 0.1% SA. ASA slowed down the increase in LOX activity and superoxide free radical production, and suppressed ACC synthase and ACC oxidase activities and biosynthesis of ethylene, and hence retarded the climacteric rise in ethylene production. Fruit ripening and senescence were also delayed (Zhang, Chen, Zhang, & Ferguson, 2003). The investigations indicated the ripening-delaying of postharvest fruits by SA.

Chilling injury is an important factor that limits the duration of cold storage of fruits and vegetables. The SA at 0.001 g/L SA could significantly decrease the cell membrane electrolyte leakage and MDA content of cucumber stored at chilling injury temperature as well as decrease free proline content in some extents (Han, Li, & Feng, 2002). The contents of MDA or free proline in peaches stored at chilling temperatures with SA treatment were lower than those without SA (Han and Li, 2001). It was confirmed that SA enhanced the endogenous H<sub>2</sub>O<sub>2</sub> content in the beginning of chilling-injury storage, postponed the increases of MDA and relative electrolyte and increased the activities of CAT and ascorbic acid peroxidase (APX). The results above predicted that it was possible for SA to reduce chilling injury or to induce cold tolerance of chilling-sensitive fruits.

### **3 Problems existing in SA application**

The effects of SA in various fruits were dependent on its concentrations applied. Seldom investigation displayed the positive relation between the improvement effect and the SA applied concentration. Fruit injuries were observed by extra SA in a couple of products.

0.1 g/L SA displayed the positive preserving of fruits in peach (cv. Okuba) and persimmon (cv. Mopan), but peel injury appeared in peach when SA were 0.3 g/L above. The peach fruits with 0.5g/L, 1.0 g/L, 1.5 g/L SA showed peel-browning in 1.0-2.5 hrs following immersion and got worse within 24 hrs. The softening of both fruits was speeded up by SA at 0.5 g/L above, especially at 1.0 g/L above (Li and Han, 1999, 2000b) . Black or browning spots appeared at peel of Pinguoli pear with SA at 1.5 g/L above, and edible value lost (Cao et al., 2001).

Ram and Vir (1983) observed color-changing of peel in banana with extra SA. We also found that the yellow-changing in cucumber with 0.5 g/L and 1.0g/L during shelf life at room temperature was faster than in control. The 0.1% SA decreased the rot and respiration rate of mango but the 0.2% SA demonstrated the opposite. These indicated that there are big differences of suitable concentrations applied among products or varieties.

The preserve effect in persimmon (Li and Han, 2000b) was not obvious just like in peach (Li and Han, 1999) , tomato, apple, Yali pear. In Dongzao jujube (*Zizyphus jujube* Mill cv. Dongzao) fruit SA application even low at 0.01% for 5 min promoted flesh softening and rot as well as accumulating of soluble sugar (Gao et al., 2007). It might be related with the low ethylene production and comparable high pH value.

It was reported that SA inhibited the ethylene biosynthesis in apple or pear cell suspension cultures and the effects were dependent on pHs The inhibition reduced as pH value raised among pH3.5-6.5, stopping at pH 6.5 above (Leslie and Romani, 1986, 1988) .

We thought that the fruits of peach, tomato, and apple were a little bit low pH, and the inhibited degree of ethylene biosynthesis in flesh was significant. In addition these fruits are typical climatic fruits and produce more ethylene, whose ripening and senescence are regulated by ethylene. As a result SA displayed the positive effects of preservation on the fruits. On a contract persimmon is low ethylene production as well as high pH (compared to the fruits mentioned above). The low efficacy of preservation was the result in persimmon. More investigations are needed for physiological response of products to SA.

## 4 Conclusions

There were theoretical foundations on SA application, which included the inducing of disease-resistance. A lot of research had demonstrated that SA application improved the quality as well as their relative physiological parameters for some of horticultural products. The accuracy of SA concentration or cooperation with other techniques will be the keys to SA application.

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# Study on Changes in Microorganisms flora of Jinhua ham during fermenting

He Zhifei<sup>1</sup> Zhen Zongyuan<sup>2</sup> Hongjun Li<sup>1</sup> Guanghong Zhou<sup>2</sup> Zhang Jianhao<sup>2</sup>

<sup>1</sup> College of Food Science, Southwest University, Chongqing 400716, PR China

<sup>2</sup> College of Food Science and Technology, Nanjing Agricultural University, Nanjing, 210095, PR China

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**Abstract.** Studied on the microorganisms flora carefully during Jinhua ham fermentation with traditional technology. Numbers and varieties of microorganisms were checked up regularly, also tested the water, salt content and pH value. Results showed that microorganisms numbers and varieties of Jinhua ham are only a few at first, increasing quickly to  $10^6$  cfu/g during the ham fermenting, at last it decreased to below  $10^3$  cfu/g. The main bacteria are *Staphylococcus*, *Lactobacillus*. The predominant yeasts are *Candida Zeylanoides*, *Debaryomyces hansenii*, *Hansenula sydowiorum* and *Rhodotorula glutinis*. The molds are main *Penicillium* and *Aspergillus*, the former including *P. italicum*, *P. simplicissimum* and *penicillium citrinum*, the later contains *A. sydowi*, *A. glaucus*, *A. flauipes* and *A. oryze*. It has the relationship between the flavor of Jinhua ham and microorganisms flora.

**Keywords.** Dry-cured; Chinese Jinhua ham; Fermentation; Microbial flora; Identification

## 1. Introduction

Chinese Jinhua ham belongs to dry-cured ham of the meat products, originated in Jinhua region of Zhejiang province about 900 years ago. It is the most famous traditional meat product in China. It is similar to the famous dry-cured hams in the world, mostly come from Mediterranean area for example, primarily Iberian ham and Serrano ham in Spanish, Parma ham and San Danielle ham in Italy, Bayonne ham and Corsica ham in France, country ham in America and Westphalia ham in Germany and so on (Du & Ahn, 2001, Chen Shiyi & Weng Zhifen, 1980). The common characteristics of these hams are that many physicochemical reactions were taken place in the interior of muscle during a long curing, fermenting and ripening period of over 10 months, especially many kinds of microbial contribute to formation of flavor compounds in the fermentation of Jinhua ham, which make Jinhua ham become meat products with characteristic flavor (Buscailhon et al., 1994). Many reports describing Western-style dry-cured hams have been published (Buscailhon et al., 1994;

Garcia et al., 1991; Vestergaard, Schivazappa & Virgili, 2000; Yanjun Huan & Guanghong Zhou, 2005). However, few research work have been done on the situation of microorganisms flora of Chinese Jinhua dry-cured ham, especially in Jinhua ham fermentation.

This study reports the changes in microorganisms flora of Chinese Jinhua dry-cured ham during processing. It begins studying on Jinhua ham in microbiology. The microorganisms numbers and varieties of Jinhua ham were determined in the various processing stages with microbiological methods, and microbial changes were analyzed.

## **2. Materials and methods**

### **2.1. Ham processing**

Traditional processing of Jinhua ham was under natural condition in Zhejiang Provincial Food Company in China. Good quality of Jinhua ham related to strict requirement of ham materials and fine processing technique, the specific geography and climatic conditions of processing area were also important factors. Jinhua area of Zhejiang has defined seasons, the temperature changed orderly and fluctuated steadily, so the place was a desirable climatic district for processing dry-cured ham meat products. Traditional processing of Jinhua ham was complex of more than 90 steps. But the key processing procedures were similar to dry-cured ham in Southern Europe (Brian J.B. Wood., 2001), which mainly concluded curing, washing and sunning, fermentation and ripening, packing and post-ripening. Thirty trimmed raw hams, each of which weighed 5.5 - 6.2 kg from hind legs of liangtouwu crossbred pigs (6 - 7 months, 100 - 120 kg) were salted and cured in which salt was added 5-7 times (30 mg of sodium nitrate/kg of the raw ham was mixed in the salt used at the second time) for 30 d. After soaking and washing for 24 h and sun-drying for 20 days, hams were fermented in workshop for 150 days, then ripened under environmental conditions for 160 days. During the hams processing, room temperature and relative humidity in workshop were tested and recorded 3 times a day.

### **2.2. Ham sampling**

The Biceps femoris muscle was cut from five hams taken randomly after each of the key processing stages, sampling twice a month, separately from the surface and deep of hams. Surface sampling referred to GB-4789.28-94-5.3(China), interior sampling referred to GB-4789.17-94-5.2(China). Then immediately packaged and stored at -40°C until microbiology analysis. Sampling stages, mean temperature and relative humidity (RH) during each of the key processing stages and sampling time are recorded correctly.

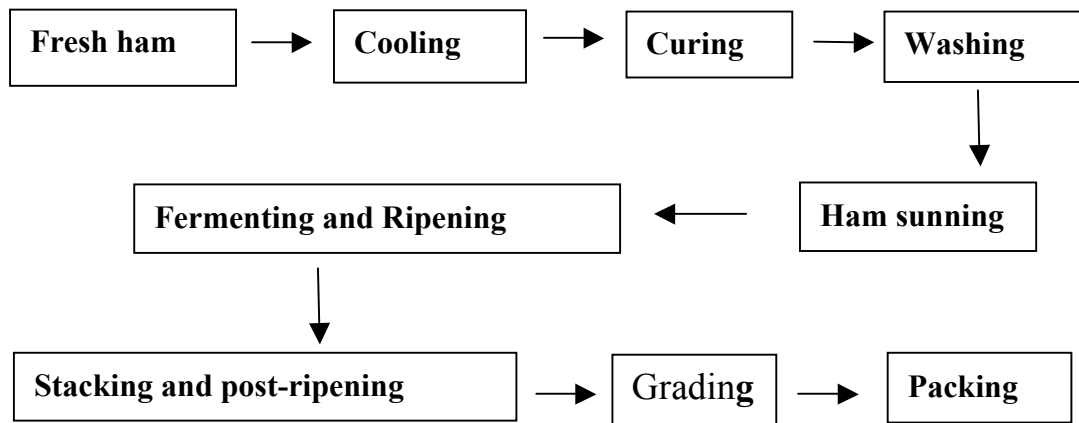
### **2.3. Flora count determination**

Refer to methods of GB-T4789.2-1994(China).

### **2.4. Bacterial identification**

Refer to *Microbiology Experimental Handbook* (Zhou Deqing, FuDan University in Shanghai, China). Make classical determination of morphologic characteristics, physiological and biochemical characteristics, ecological characteristics and so on.

### **2.5. Flow chart of Jinhua ham processing technique**



**Fig. 1 . Flow chart of Jinhua ham processing**

### 2.6. Mould and yeast count

Refer to methods of GB-T4789.15-1994(China).

### 2.7. Yeast identification

Refer to *Lodder Classification Handbook* (Zhou Deqing, FuDan University in Shanghai, China). Combining identification of morphological, physiological and biochemical characteristics.

### 2.8. Mould identification

Refer to methods of Ainsworth(), chiefly according to identification of morphological characteristics.

### 2.9. Water and NaCl content determination

Respectively refer to determination methods of water and NaCl content in GB-T9695.15-88 and GB-T9695.8-88(China).

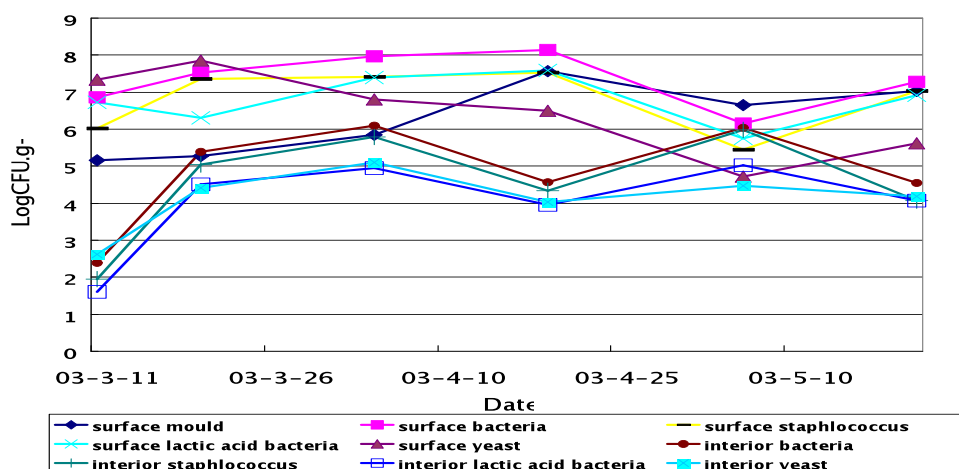
### 2.10. pH value determination

Refer to pH determination methods of GB-T9695.5-88(China).

## 3. Results and discussion

### 3.1. Change of microbial counts in pre-fermentation

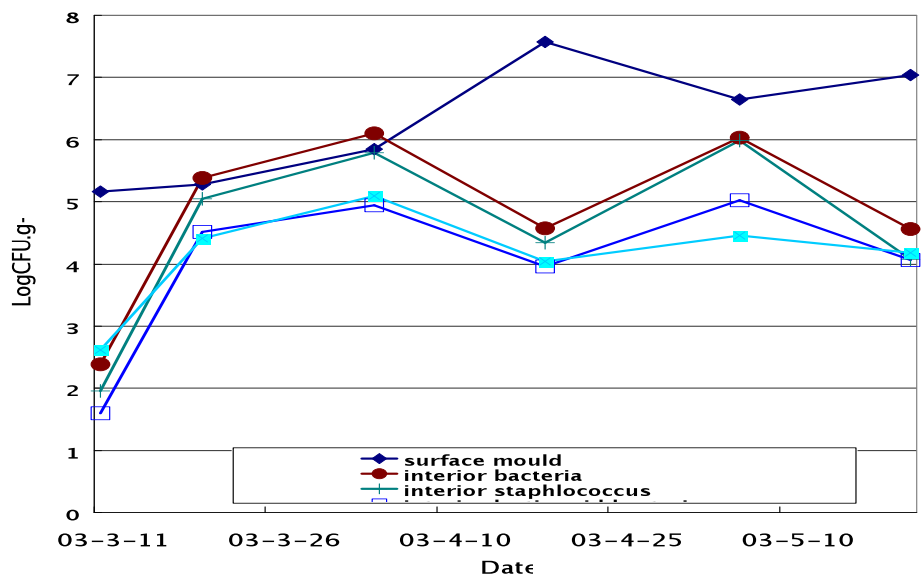
Pre-fermentation was the stage when hams hung to dry and set into fermentation room. Temperature and humidity were proper at this time, water content of hams was still higher. So the surface and interior of hams rich in many kinds of microorganisms at the stage (see fig.2 ).



**Fig. 2. Change of microbial counts in pre-fermentation**

Up to 120 days (03-3-11), hams samples in fermentation room were detected. The results were that surface and interior microorganisms were both increase, especially yeasts. They increased faster because temperature and humidity were proper with an elevated temperature, the interior bacteria counts increased rapidly, staphylococcus predominated, lactic acid bacteria the second, yeasts also had a large amount. Counts of staphylococcus, lactic acid bacterial, yeasts were large enough to affect meat fermenting. A small quantity of mould mycelial

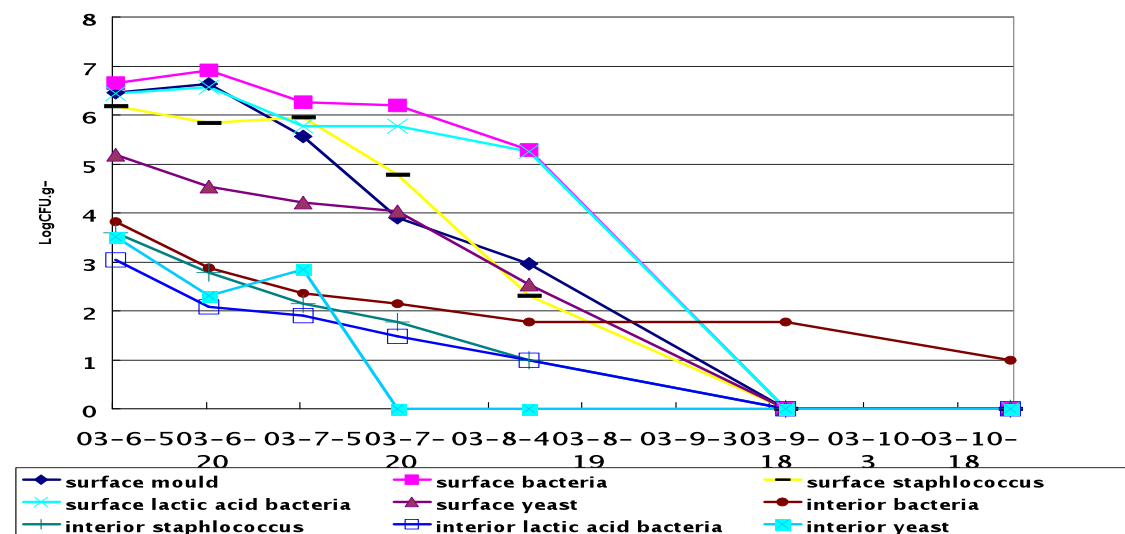
Filaments had grown during fermenting, the interior microorganisms further increased, reaching the maximum counts. The whole meat was covered with mycelial filaments and reached the maximum counts. In the later of fermentation (03-5-10), the surface of hams was covered with moulds over again. But the interior microbial counts dropped again (see Figure3 and Figure4).



**Fig.3. Change of surface moulds in pre-fermentation and interior microorganisms**

**3.2. Microbial change in post-fermentation**

Temperature gradually increased in post-fermentation, so microbial counts would steadily decreased.



**Fig. 4. Change of microbial counts in post-fermentation**

After 210 days (03-6-5), in the high-temperature stage in summer, the surface and interior microbial counts both dropped gradually because of steady dehydration and low water content (51.99%-55.14%). Sampling was carried out before hams which gone downstairs, stacked and post-ripened. Due to the high temperature (35°C-40°C), the surface mould counts had been in minute amount. The interior microbial counts were small in amount too, because water activity was very low in the interior of hams. At this time, the surface of hams was put on a coat of oil, so water activity was quite low, basically there was no microorganisms detected.

### **3.3. Results of bacteria identification**

According to results of physiological and biochemical experiments and refer to *Berger Bacteria Identification Handbook*, bacteria participating in ham fermentation were mostly staphylococcus and next lactic acid bacteria. The predominant spp. were *S.equorum* and *S.gallinarum*; *Lactobacillus alimentarius*, *P.urinaeequi* and *P.pentosaceus* predominated in lactic acid bacteria. Ohterwise, micrococcus varians also had a large amount.

### **3.4. Results of yeast identification**

According to experimental results and refer to *Yeast Identification Handbook*, *Candida Zeylanoides*, *Debaryomyces hansenii*, *Hansenula sydowiorum*, *Rhodotorula glutinis* predominated were in yeast flora.

### **3.5. Results of mould identification**

There were a variety of moulds on ham surface, predominated moulds were all Fungi Imperfect Moniliales, *P.italicum*, *P.simplicissimum* predominated in *Penicillium LK.ex Fries*, *Aspergillus Micheli ex Fr.* included *A.oryzae*, *A.glaucus* and *A.sydowi*. What's more, there were *P.camemberti* Thom, *Penicillium citrinum* and so on.

## **4. Conclusions**

Microbial counts and predominant flora in Jinhua ham during processing were detected in the experiment. The conclusions of this test showed microbial were basically found after salting. But it increased after some days in sun. Interior microbial counts increased rapidly too after entering fermentation room. It proved microbe interior ham came from outsides and went into ham after salting.

Maximum of microbe interior ham reached to  $10^6$ cfu/g, which was enough to affect flavor of hams. But the count decreased to lower values ( $<10^3$ cfu/g) in the ripening period (processed for 210days-240days), so it was sure that the interior microbe of ham works before the ripening period.

The microbial flora on the surface of Jinhua hams influenced each other, but moulds on the surface really affected interior microbial counts. In the early stage, both increased, when mould counts increased to a certain level, it would inhibit growth of interior microbe, so the counts dropped; but when mould counts dropped, interior bacteria counts increased.

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### **Vitae**

He Zhifei,

Professor of Food Microorganism and Fermentation, College of Food Science, Southwest University, Chongqing, P. R. China.

Email: zfhe2003@yahoo.com.cn

Hongjun Li:

Corresponding author, Tel.: 86-13635454739, 86-23-68251902;

Fax: 86-23-68251949 Email: hongjunli1961@yahoo.com.cn

Professor of Agricultural product Processing and Preservation (meat science is the main research field), College of Food Science, Southwest University, Chongqing, P.R.China.

## The Sustainable Food Production in Brazil: How Far Can We Go to Feed the World?

Luis Henrique de Barros Soares\* ; Veronica Massena Reis; Robert Michael Boddey.

Embrapa Agrobiologia, Rodovia BR-465, km 07, Seropédica, Rio de Janeiro, Brazil.  
Phone: +552134411500; fax: +552126821230

Type of presentation. ORAL

Contact person. [luis.henrique@cnpab.embrapa.br](mailto:luis.henrique@cnpab.embrapa.br)

**Abstract.** *Fostered by a dynamic and stable domestic economy, and by the growing international demand for grains, fiber and renewable bioenergy, Brazil harvested last season a record of 147 million tons of grains, an increase of 9.4% as compared to 2009. However, the planted area did not change significantly, staying in a little over 47 million of hectares, less than 6% of its large territory. The expansion of the agricultural frontier for the establishment of plantations has been strongly discouraged at present, since it is estimated that there are at least another 50 million hectares suitable for intensive use only in the Cerrado, the Brazilian savannah. At the same time, the recovery of degraded pastures and the intensive use of conservation practices such as crop-livestock integration to mitigate emissions of greenhouse gases are stimulated in the fields. Even though a large quantity of agricultural inputs is still imported, the widespread adoption of practices of inoculation to promote biological nitrogen fixation provides annual savings of about 3.2 billion of Euros per year, only for soybean. This fact minimizes the emission of N<sub>2</sub>O and increases the whole sustainability in terms of energy balance. For sugarcane, the gradual elimination of cane burnings prior to harvesting until its abolition by 2022, with legal basis, will tend to reduce the levels of air pollution and increase carbon stocks in soil. To meet the quality criteria of the international consumer markets of the Brazilian agricultural commodities, a number of initiatives are being taken aiming to give greater transparency in the food production chains regarding the use of natural resources, energy efficiency, environmental and social impact, and the conduction of further life-cycle studies.*

**Keywords.** Leave the word "Keywords." then type keywords or key phrases, separated by commas. List both specific and general terms that will aid in searches.