Nipa leaves are quite durable and used for thatching houses. Every year, from December to May, thousands of “bawalis” (traditional forest users) collect an average of 60,000 metric tonnes of fronds from Sundarban Reserve Forest. The fronds are sold at several trade depots in the adjoining districts and used as a traditional roofing material throughout the country. The fruits are used to make a local wine.

No report is available on the properties of *golpata* fronds and its pulpability. Hence, the chemical, morphological and anatomical studies of *golpata* fronds have been done by researchers in Bangladesh to evaluate its suitability as pulping raw material. *Golpata* fronds were collected from Sundarban area and allowed to air dry. Leaves were removed from the fronds and fronds were chopped to 2-3 cm in length by chopper. The lignin, pentosan and \( \alpha \)-cellulose in *golpata* fronds were comparable to some common non-wood and hardwood raw materials. The alkali, water and dichloromethane solubility were higher than wood and common nonwood. The fibre length (1.73 mm) was observed to be little shorter than softwood and longer than hardwood but fibre diameter was very short. The pulpability of *golpata* fronds has also been studied. The pulp yield was very low and Kappa number was high. The strength properties were better than that of some common non-wood pulps. FT-IR spectrum and alkaline nitrobenzene oxidation products showed that *golpata* fronds lignin mainly consist of syringyl and guaiacyl units [Jahan, M Sarwar, Chowdhury DA Nasima and Islam M Khalidul, Characterization and evaluation of golpata fronds as pulping raw materials, *Bioresour Technol*, 2006, 97(3), 401-406].

**Capsaicinoids affect carotenoid stability in paprika**

The major carotenoids and carotenoid esters in *Capsicum annuum* Linn. during thermal dehydration of pepper and storage of the ground product (paprika) were examined by the scientists at Hungary with special focus on the role of endogenous antioxidants such as vitamins E and C and capsaicinoids, the pungent materials in hot spice red pepper. A HPLC method was developed to achieve excellent separation and accurate detection of different carotenoid classes including free xanthophylls, monoesters, carotenes and di-esters. The newly developed method included gradient elution on a reversed-phase column with increasing proportions of isopropanol.

The results indicated that presence of capsaicinoids in pungent pepper had a favourable effect on the stability of carotenoids during thermal drying. Various di-esters of lutein and zeaxanthine, and mono-ester of \( \beta \)-cryptoxanthin were more stable than capsorubin and capsanthin, pointing to the possible role of epoxide and carbonyl groups in the susceptibility of carotenoids. An Arrhenius plot for degradation of carotenoids, tocopherols and ascorbic acid as a function of drying temperature showed linear relationships for all components with ascorbic acid being the most sensitive. During storage in a refrigerator for 3 months the paprika showed high degradation of all the examined carotenoids particularly in samples prepared from pods dried at high temperatures (90°C and 100°C). An exception was for \( \beta \)-cryptoxanthin mono-ester and violaxanthin di-esters in a non-pungent variety. The amounts of these carotenoids lost during storage were slightly affected by the change in drying temperature. Strong correlation was found between retention of colour in stored paprika and the initial content of ascorbic acid but not with that of tocopherols or capsaicinoids [Daood Hussein G, Kapitány József, Biacs Péter and Albrecht Katalin, Drying temperature, endogenous antioxidants and capsaicinoids affect carotenoid stability in paprika (red pepper spice), *J Sci Food Agric*, 2006, 86(14), 2450–2457].
The colour of Paprika, which is one of the most important quality measured, is drastically affected by the drying process of red peppers, hence the scientists at Department of Farm Machinery, Faculty of Agriculture, Gaziosmanpasa University, Tokat, Turkey conducted study to measure ability of three different chemical solutions (i) 2% ethyl oleate, (ii) 2% ethyl oleate+2% NaOH and (iii) 2% ethyl oleate+2% NaOH+4% K2CO3 in w/v on the colour retention of dehydrated red peppers in association with dipping temperature (23°C and 60°C) and drying method (greenhouse drying and open sun drying). The surface colour was measured by a reflection colorimeter.

Results revealed that all pretreatments significantly accelerated drying process. But their effects diminished towards the end of drying, since the length of drying time is considerably long. However, their effects on the final colour of dried red peppers are more remarkable. Red peppers dipped in ethyl oleate solution and non-pretreated red peppers (the controls) experienced severe colour change to blackish colour. Dipping red peppers in the solution of 2% ethyl oleate+2% NaOH+4% K2CO3 at 60°C dipping temperature resulted in the best color retention [Ergünes Gazanfer and Tarhan Sefa, Color retention of red peppers by chemical pretreatments during greenhouse and open sun drying, J Food Eng, 2006, 76(3), 446-452].

Lipid-lowering efficacy of piperine from *Piper nigrum* Linn.

Black pepper (*Piper nigrum* Linn.), also called the “King of Spices”, is one of the oldest and world’s most important spices used in traditional Indian Ayurvedic and Siddha Medicine, as well as in various therapeutic measures in the traditional system of medicine. It contains active chemical constituent, piperine (1-piperoyl piperidine), which exhibits diverse pharmacological properties and was evaluated for its potential to enhance the bioavailability of drugs and nutrients in animals and humans. Piperine exhibits antioxidant activity in streptozotocin-induced diabetic rats and alters lipid peroxidation and glutathione metabolism in the liver and intestine in various experimental conditions. Different approaches are used to reduce the incidence and to treat cardiovascular disease (CVD). Popular among them are drug therapy, diet therapy and recently, therapy with spices and other natural products.

Preliminary studies at Department of Biochemistry and Biotechnology Annamalai University, Annamalainagar, Tamil Nadu, India were performed to assess the effect of black pepper on HFD-fed (high-fat diet) rats, which showed its beneficial action in preventing lipid accumulation in plasma and tissues. During experiment male Wistar rats were divided into two groups: control diet group and high-fat diet group. Both groups were divided into four subgroups, each consisted of 10 animals, and the diets were supplemented with the following ingredients for 10 weeks:

1. 1% carboxymethyl cellulose;  
2. 10mg carbimazole (CM)/kg body weight;  
3. 10mg CM+40mg piperine/kg body weight; and  
4. 10mg CM+2mg atorvastatin/kg body weight. Feeding HFD to rats significantly (*P*<0.05) elevated plasma total cholesterol, triglycerides, phospholipids, free fatty acids, low-density lipoprotein (LDL), very low-density lipoprotein (VLDL) and the activity of 3-hydroxy 3-methyl glutaryl coenzyme A (HMG CoA) reductase in the liver, heart and aorta, while the activities of plasma and tissue lipoprotein lipase (LPL) and plasma lecithin cholesterol acyl transferase (LCAT) and high-density lipoprotein were significantly (*P*<0.05) lowered compared to control rats. Supplementing piperine with HFD significantly (*P*<0.05) reduced the levels of plasma total cholesterol, LDL, VLDL tissue HMG CoA reductase and significantly (*P*<0.05) elevated the levels of LPL and LCAT compared to rats that did not receive piperine. Fecal bile acids and neutral sterols were also elevated in HFD-fed rats as compared to control animals, while simultaneous supplementation of piperine significantly (*P*<0.05) enhanced further excretion of bile acids and neutral sterols. The results indicate that piperine can prevent the accumulation of plasma lipids and lipoproteins significantly by modulating the enzymes of lipid metabolism [Vijayakumar, Subramaniam Ramasamy and Namasiyayam Kalini, Lipid-lowering efficacy of piperine from *Piper nigrum* L in high-fat diet and antithyroid drug-induced hypercholesterolemic rats, J Food Biochem, 2006, 30(4), 405-421].
Instant *chutney* powder from raw tamarind

Tamarind (*Tamarindus indica* Linn.), belonging to the family Caesalpinaceae is grown throughout tropical and subtropical regions of the world and has become naturalized in many places. It is one of the most common and important cash trees of India. Each part of the tree finds some use, but the most useful part is the fruit, which yields acidic pulpy material and hence is widely used for souring curries and sauces, Tamarind fruit can also be used to make different products, such as tamarind powder, tamarind juice concentrate, tamarind paste, tamarind kernel powder, tartaric acid, pectin, tartarates and the fruit contains 10-14% tartaric acid on the dry weight basis.

The scientists at Central Food Technological Research Institute-Resource Centre, Habshiguda, Hyderabad, India conducted study in order to develop a standard recipe for instant *chutney* powder using raw, green and unripe tamarind pods. Soursness, pungency and salt are the most important characteristics of the instant *chutney* powder. Raw tamarind powder was prepared by drying raw, green and unripe tamarind paste and all of the powder components such as chili, coriander, turmeric and salt were mixed in suitable quantities, blended in a laboratory mixer and passed through a B.S No. 40 (420µ) sieve. The recipe was standardized by preparing several batches with varying quantities of chili powder, coriander powder and salt, in order to obtain good palatability and to retain the natural tamarind flavour. The proximate and mineral composition of the dry raw tamarind powder and instant raw tamarind *chutney* powder were determined. The acid content as tartaric acid was 12.6% and 5.8% in the dry raw tamarind powder and instant *chutney* powder, respectively. Other components in the instant *chutney* powder and dry raw tamarind powder were: fibre content, 12.7% and 18.7%; protein content, 7.7% and 10.3%; calcium, 64 and 111mg/100g; and iron, 9.5 and 4.5mg/100g, respectively. Storage studies were carried out by packing the powders in polyethylene pouches. The polyphenol content increased in both samples during the storage period. Sensory analyses showed that the instant raw tamarind *chutney* powder scored 7.2 (above good) even after the 6-month storage period [Jyothirmayi, Rao Tummala, Galla Narsing and Rao Dubasi Govardhana, Studies on instant raw tamarind *chutney* powder, *J Foodservice*, 2006, 17(3), 119-123].

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**Ginger is good in obesity**

*Zingiber officinale* Rosc. commonly known as Ginger (Hindi — Adrak) is one of the commonly used spices in India and around the world. Ginger is reported to have various pharmacological activities like anti-emetic, antiulcer, antiolytic, anti-inflammatory and antipyretic activities. Earlier studies had demonstrated that fresh juice of ginger reduces the elevated lipid levels associated with hyperglycaemia in streptozotocin-induced type I diabetic in rats. It was also correlated that reduction in the serum glucose levels are mediated by 5-HT receptor antagonism. However, in earlier studies reduction in serum glucose levels were seen in conditions of hypoinsulinemia.

The researchers at Department of Pharmacology, L. M. College of Pharmacy, Navarangpura, Ahmedabad, India evaluated ginger for its beneficial effects in conditions of hyperglycaemia associated with hyperinsulinemia, hyperlipidemia and increased abdominal fat deposition which represents obesity. Goldthioglucose induces in mice a significant increase in body weight, glucose, insulin and lipid levels. Treatment with 250 mg/kg of methanol and ethyl acetate extracts of ginger for 8 weeks produces significant reduction in body weight, glucose, insulin and lipid levels as compared to obese control mice. The reduction in elevated glucose along with elevated insulin levels indicates that the treatment with ginger improves insulin sensitivity. From the study, it is concluded that methanolic and ethyl acetate extracts of ginger has beneficial effects in conditions of obesity. In addition to decrease serum glucose, insulin and lipid levels it can also...
significantly retard gain in body weight. Based on these beneficial effects, ginger can be considered as supplementary herbal therapy in obese patients for prevention or treatment of obesity [Goyal Ramesh K and Kadhur Sanjay V. Beneficial effects of Zingiber officinale on goldthioglucose induced obesity, Fitoterapia, 2006, 77(3), 160-163].

Antifungal and antioxidative potential of Fennel oil

Fennel, *Foeniculum vulgare* Mill. (Hindi — *Saunf*) is a small genus of annual, biennial or perennial herbs widely cultivated throughout the temperate and tropical regions of the world for its aromatic fruits, which are used as a culinary spice. Steam distillation of dried fruits yields an essential oil referred as ‘Fennel oil’, used in western countries for flavouring purposes.

Chemical, antifungal and antioxidant studies of fennel fruit volatile oil and its acetone extract have been undertaken by researchers of India and Argentina. GC and GC–MS analysis of fennel volatile oil showed the presence of 35 components containing 96.4% of the total amount. The major component was *trans*-anethole (70.1%). The analysis of its acetone extract showed the presence of nine components accounting for 68.9% of the total amount. Linoleic acid (54.9%), palmitic acid (5.4%) and oleic acid (5.4%) were found as major components in extract. The antifungal and antioxidative potentials were also carried out by different techniques. In inverted petriplate method, the volatile oil showed complete zone inhibition against *Aspergillus niger*, *A. flavus*, *Fusarium graminearum* and *F. moniliforme* at 6 µL dose. It was found to be effective for *A. niger* even at 4 µL dose. Moreover, using food poison technique, the volatile oil and extract both showed good to moderate zone of inhibition. The antioxidant value was evaluated by measuring peroxide and thiobarbituric acid values for linseed oil at fixed time intervals. Both, the volatile oil and extract showed strong antioxidant activity in comparison with butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT). In addition, their inhibitory action in linoleic acid system was studied by monitoring peroxide accumulation in emulsion during incubation through ferric thiocyanate method. It is concluded that fennel volatile oil, which is rich in *trans*-anethole, possesses good antifungal activity against *A. niger*, *A. flavus*, *F. graminearum* and *F. moniliforme* whereas its acetone extract, which is rich in linoleic acid, can be used as natural antioxidant for linseed oil. Hence, they are valuable for increasing shelf-life of foodstuffs and protector for highly unsaturated linseed oil, replacing synthetic fungicides and antioxidants such as BHT and BHA, as well as for preventing cellular damage, the cause of ageing and human diseases [Singh Gurdip, Maurya Sumitra, de Lampasona MP and Catalan C. Chemical constituents, antifungal and antioxidative potential of *Foeniculum vulgare* volatile oil and its acetone extract, Food Control, 2006, 17(9), 745-752].

Antimicrobial effect of spices and herbs on *Vibrio parahaemolyticus*

*Vibrio parahaemolyticus* is a bacterium which causes mild gastroenteritis in humans on consumption of infected seafood. The bacterium generally inhabits coastal environments in tropical and temperate zones, and contaminates fishery products caught in these areas, especially during warm periods. In Japan, a variety of seafood has been traditionally consumed and raw or lightly cooked seafood is favoured. This eating habit seems to provide an explanation for many cases of foodborne disease by *V. parahaemolyticus* in the country. Some efforts are needed to enhance the safety of seafood. Antimicrobial activities of spices and herbs and essential oils have been well known for long time. Many studies reported the activities of spices and herbs or essential oils to foodborne pathogenic bacteria.
The antimicrobial effects of 18 plant species of spices and other herbs were investigated by researchers at Seafood Safety Section, National Research Institute of Fisheries Science, Yokohama, Japan on a foodborne pathogen, *Vibrio parahaemolyticus*, with the use of combinations of temperatures and nutrient levels. Basil, clove, garlic, horseradish, marjoram, oregano, rosemary and thyme exhibited antibacterial activities at incubation of 30°C, while with the exception of horseradish, the same spices and additional 7 species exhibited the activities at 5°C. The lowest MIC (minimum inhibitory concentration) was 0.125% observed in clove and marjoram at 30°C in a nutrient rich medium. Lowering of incubation temperature produced little effect on the MICs except for turmeric. The decreasing of the MIC in turmeric appeared to be basically attributed to the sensitivity of the bacterium to coldness. In nutrient poor medium, the lowest was 0.001 and 0.00025% in marjoram at 30°C and at 5°C, respectively. The sensitivity to several spices and herbs was similar among different clinical serotypes including the emerging strain O3:K6. These results suggest that the spices and herbs can be practical for protecting seafood from the risk of contamination by *V. parahaemolyticus* [Yano Yutaka, Satomi Masataka and Oikawa Hiroshi, Antimicrobial effect of spices and herbs on *Vibrio parahaemolyticus*, Int J Food Microbiol, 2006, 111(1), 6-11].

### Chemopreventive efficacy of Ginger

Ginger (*Zingiber officinale Rosc.*) is a natural dietary component, which has antioxidant and anticarcinogenic properties. Ginger is extensively used as a food additive in India where colon cancer incidence is low as compared to the western population. Colorectal cancer is one of the leading causes of cancer death both in men and women. Evidence from epidemiological studies and laboratory animal assays suggest a relationship between colon cancer risk and dietary factors. Differences in dietary habits have been used to explain the disparate geographic distribution of colon cancer rate worldwide. The researchers at Department of Biochemistry, Faculty of Science, Annamalai University, Annamalainagar, Tamilnadu, India investigated the effect of ginger on the initiation and post-initiation stages of carcinogenesis. The activity of lipid peroxidation was studied by measuring the formation of thiobarbituric acid reactive substances (TBARS), lipid hydroperoxides (LOOH) and conjugated dienes (CD), and the antioxidant status by measuring superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), glutathione-S-transferase (GST), glutathione reductase (GR), reduced glutathione (GSH), vitamins C, E and A concentrations in the circulation of 1,2-dimethylhydrazine-induced experimental colon cancer.

In the presence of a known colon carcinogen, DMH, plasma lipid peroxidation (TBARS, lipid hydroperoxides and conjugated dienes) and cancer incidence were significantly increased whereas enzymic (GPx, GST, GR, SOD and CAT) and non-enzymic antioxidant concentrations (GSH, vitamins C, E and A) were decreased as compared to control rats. The number of tumours as well as the incidence of cancer was significantly decreased on treatment with ginger. In addition, ginger supplementation at the initiation stage and also at the post-initiation stages of carcinogenesis significantly reduced circulating lipid peroxidation and significantly enhanced the enzymic and non-enzymic antioxidants as compared to unsupplemented DMH-treated rats. Ginger supplementation suppresses colon carcinogenesis in the presence of the procarcinogen DMH.

The results suggest that administration of ginger during the initiation as well as the post-initiation stages of carcinogenesis significantly inhibited cancer incidence, decreased circulatory lipid peroxidation and enhanced enzymic and non-enzymic antioxidant concentrations. Ginger has no toxic effects and it is protective against...

### Antioxidant and radical scavenging activities of black pepper

Antioxidants have been widely used as food additives to provide protection against oxidative degradation of foods. Spices are well known for their antioxidant properties. Water and ethanol crude extracts of black pepper (*Piper nigrum* Linn.) were investigated at Department of Chemistry, Atatürk University, Faculty of Science and Arts, Erzurum, Turkey for their antioxidant and radical scavenging activities in six different assays, namely, total antioxidant activity, reducing power, 1,1-diphenyl-2-picryl-hydrazyl (DPPH) free radical scavenging, superoxide anion radical scavenging, hydrogen peroxide scavenging and metal chelating activities. Both water extract (WEBP) and ethanol extract (EEBP) of black pepper exhibited strong total antioxidant activity. The 75µg/ml concentration of WEBP and EEBP showed 95.5 and 93.3% inhibition on peroxidation of linoleic acid emulsion, respectively. On the other hand, at the same concentration, standard antioxidants such as butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT) and α-tocopherol exhibited 92.1, 95.0 and 70.4% inhibition on peroxidation of linoleic acid emulsion, respectively. Also, total phenolic content in both WEBP and EEBP were determined as gallic acid equivalents. The total phenolics content of water and ethanol extracts were determined by the Folin-Ciocalteu procedure and 54.3 and 42.8µg gallic acid equivalent of phenols was detected in 1mg WEBP and EEBP.

Thus, results of the study clearly indicated that WEBP and EEBP have high antioxidant and radical scavenging activities against various antioxidant systems *in vitro*. These assays have important applications for the food industry. Moreover, black pepper can be used as easily accessible source of natural antioxidants and as a possible food supplement in the food industry. Further work could be performed on the isolation and identification of the antioxidant content of WEBP and EEBP. Furthermore, *in vivo* antioxidant activity of both extracts and different antioxidant mechanisms is necessary in further investigations [Gülçin Ilhami, The antioxidant and radical scavenging activities of black pepper (*Piper nigrum*) seeds, *Int J Food Sci Nutr*, 2005, 56(7), 491-499].

### Spices as beneficial antidiabetic food adjuncts

Diet has been recognized as a cornerstone in the management of diabetes mellitus. Spices are the common dietary adjuncts that contribute to the taste and flavour of foods. Besides, spices are also known to exert several beneficial physiological effects including the antidiabetic influence. A scientist working in Central Food Technological Research Institute, Mysore, India had given an overview of all the available information from animal experimentation as well as clinical trials, where spices, their extracts or their active principles were examined for treatment of diabetes. Among the spices, fenugreek seeds (*Trigonella foenum-graecum* Linn.), garlic (*Allium sativum* Linn.), onion (*Allium cepa* Linn.) and turmeric (*Curcuma longa* Linn.) have been experimentally documented to possess antidiabetic potential. In a limited number of studies, cumin seeds (*Cuminum cyminum* Linn.), ginger (*Zingiber officinale* Rosc.), mustard (*Brassica nigra* (Linn.) Koch), curry leaves (*Murraya koenigii* (Linn.) Spreng.) and coriander (*Coriandrum sativum* Linn.) have been reported to be hypoglycaemic.
A few of the common spices (fenugreek, garlic, onion, turmeric and cumin) are thus understood to have beneficial antidiabetic properties based on several animal studies. The antidiabetic potency is also evidenced in human trials in the case of fenugreek and onion. These hypoglycaemic spices may be used in conjunction with antidiabetic drugs to have better therapeutic potential and to minimize the oral hypoglycaemic drug dosage. Based on the effective dosages evidenced from experimental data, 25-50g fenugreek seeds, 5-6 cloves of garlic/50g (1 bulb) onion and 1g turmeric powder incorporated in the daily diet of diabetics could serve as an effective supportive therapy in the prevention and management of long-term complications of diabetes. This well-recognized antidiabetic action of spices seems to be mediated through: (i) stimulation of the pancreas to produce and secrete insulin, (ii) interference with dietary glucose absorption and (iii) insulin-sparing action of the constituent bioactive compounds. Such levels of these spices can be comfortably consumed in regular diet, except when their consumption is limited by the strong odour (garlic). Spice intakes at levels much higher than the average, by different sections of people, may actually be in practice depending on culinary preferences. Even among those sections of population where spice intake may not be very high, consumption of doses of these food additives comparable with the ones employed in these studies could still be practicable in order to exploit their health beneficial effect [Srinivasan K, Plant foods in the management of diabetes mellitus: Spices as beneficial antidiabetic food adjuncts, Int J Food Sci Nutr, 2005, 56(6), 399-414].

**Capsaicin and gastric ulcers**

In recent years, infection of the stomach with the organism, Helicobacter pylori has been found to be the main cause of gastric ulcers, one of the common ailments afflicting humans. Excessive acid secretion in the stomach, reduction in gastric mucosal blood flow, constant intake of non-steroid anti-inflammatory drugs (NSAIDS), ethanol, smoking, stress, etc. are also considered responsible for ulcer formation. Ulcers are common among people who are in the habit of taking NSAIDS and are infected with the organism Helicobacter pylori, responsible for excessive acid secretion and erosion of the mucosal layer. Eradication of the bacteria by antibiotic treatment and avoiding the NSAIDS eliminates ulcers and restores normal acid secretion.

A scientist working in Central Food Technological Research Institute, Mysore, India had given an overview regarding the use of red pepper (Capsicum annuum Linn.) and its active principal capsaicin and prevalence of gastric ulcers. The prevalent notion among sections of people in India and perhaps in others is that red pepper popularly known as Chili, a common spice consumed in excessive amounts leads to gastric ulcers in view of its irritant and likely acid secreting nature. Persons with ulcers are advised either to limit or avoid its use. However, investigations carried out in recent years have revealed that chili or its active principle capsaicin is not the cause for ulcer formation but a benefactor. Capsaicin does not stimulate but inhibits acid secretion, stimulates alkali, mucus secretions and particularly gastric mucosal blood flow which help in prevention and healing of ulcers. Capsaicin acts by stimulating afferent neurons in the stomach and signals for protection against injury causing agents. Epidemiologic surveys in Singapore have shown that gastric ulcers are three times more common in the Chinese than among Malaysians and Indians who are in the habit of consuming more chilies.

Interestingly, capsaicin has been found to specifically inhibit the growth of H. pylori. Capsaicin inhibits also the release of gastrin and stimulates that of somatostatin, the physiological inhibitor of acid secretion. It is also a potent inhibitor of NF-kB whose activation may lead to various pathological conditions and reactive oxygen species. Reactive oxygen species are known to be involved in the pathogenesis of gastritis, gastric ulcer, and gastric carcinoma. Capsaicin has proved to be an antioxidant protecting erythrocyte membrane, rat liver microsomes, cardiac and skeletal muscles, etc. against reactive oxygen species. Capsaicin inhibits the lipid peroxidation induced by ethanol in the gastric mucosa. The healing of ulcers is delayed in persons with gastritis and infected with H. pylori. Thus, intake of red pepper beyond its self-limiting effect may also lead to this condition [Satyanarayana MN, Capsaicin and Gastric Ulcers, Crit Rev Food Sci Nutr, 2006, 46(4), 275-328].

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**Spices**
Effect of ozonated and non-ozonated water treatment on pre-cut green peppers

The scientists at University of Bristol, UK evaluated the effect of immersing pre-cut green peppers (*Capsicum annuum* Linn.) in ozonated water at a range of ozone concentrations and for a range of contact times on the numbers of naturally occurring microorganisms. During experiment to achieve different levels of natural contamination on the peppers they were stored either pre-cut or as whole peppers, for 5 days at 5°C, before the treatments were carried out. All samples were cut into 28mm diameter discs either before storage or immediately before treatment in the case of being stored whole. Three separate trials were carried out; each trial using improved equipment to achieve higher concentrations of aqueous ozone (0.30-0.36, 0.38-0.45, and 3.85-3.95mg ozone/litre of water, respectively). In each trial, samples were either washed in agitated, non-ozonated water for 15 minutes, or in agitated, ozonated water for times ranging from 20 seconds to 30 minutes. Washing with ozonated water was not found to be significantly more effective than washing with non-ozonated water. Maximum reductions in mean Aerobic Plate Counts (APCs) of 0.66 log_{10} cfu/g were achieved by washing with non-ozonated water while maximum reductions of 0.72 log_{10} cfu/g were achieved using aqueous ozone in comparison with untreated controls. Such reductions were considered too small to be commercially viable, hence, further studies are to be done [Ketteringham Laurence, Gausseres Raphaelle, James Stephen J and James Christian, Application of aqueous ozone for treating pre-cut green peppers (*Capsicum annuum* L.), *J Food Eng*, 2006, 76(1), 104-111].

Effects of blanching and storage on capsaicinoid stability and peroxidase activity of hot chili peppers

Chili peppers (*Capsicum frutescens* Linn.) are one of the most important spices, widely cultivated and used all over the world. The amounts and characteristics of flavouring, colouring and especially pungent principles of *Capsicum* fruits are important quality parameters. Their strong pungency has been attributed to capsaicinoids, of which capsaicin and dihydrocapsaicin constitute more than 80%. Earlier an innovative process for the production of high quality spices has been developed. After harvest the fresh plant material was immediately processed into a paste and subsequently heated for microbial and enzyme inactivation. Alternatively, blanching prior to crushing of the plant material was applied. Compared to conventional spices, the products obtained from chili, coriander, ginger and green pepper were generally characterized by low microbial loads and improved colour characteristics. The improved quality was attributed to the inactivation of deteriorative enzymes such as polyphenol oxidase and lipoxygenase. Since regeneration of POD activity after heat inactivation is a well-known phenomenon, these enzymes may contribute to the degradation of capsaicinoids during storage and thus to a loss of pungency. Researchers at Institute of Food Technology, Hohenheim University, Stuttgart, Germany carried out investigations aimed at the stability evaluation of the major capsaicinoids during processing and storage for 6 months in detail. Furthermore, the impact of heat treatment on soluble peroxidase (POD) and its residual activity during storage under illumination should be investigated.

Comprising the major pungent principles capsaicin, dihydrocapsaicin and nordihydrocapsaicin, changes in capsaicinoid contents of chili powders after thermal treatment and during storage experiments were monitored. For this purpose, freshly harvested chili pods and chili pastes were immediately pasteurized at 80, 90 and 100°C for 5 and 10 minutes, respectively and finally lyophilized. Heating and drying resulted in a 21.7 to 28.3% degradation of the initial
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capsaicinoid content, the three major capsaicinoids showing similar heat susceptibility. During storage at ambient temperature over 6 months with and without illumination, further degradation of the pungent principles by 6.8-11.9% was observed. Since residual enzyme activities were assumed to cause capsaicinoid losses, soluble peroxidase activity was investigated. It was shown that immediate thermal treatment of the plant material did not result in a complete POD inactivation even under rigorous temperature-time regimes. In contrast, a regeneration of about 30% of initial POD activity was found in those samples which were first blanched at 80°C for 5 and 10 minutes and then minced. However, no correlation between POD activity and capsaicinoid losses could be established.

Besides, microbial contamination and colour properties, the pungent principles called capsaicinoids are the major quality parameters of hot chili peppers and might be influenced by peroxidase activity. The present contribution demonstrated that heating of fresh chili pods slightly diminishes capsaicinoids, which were further reduced during storage at ambient temperature irrespective of soluble peroxidase activity.

The production of high quality spices characterized by low microbial load and bright colour requires thermal treatment of the raw material; however, a slight decrease in capsaicinoid concentration cannot be excluded. To obtain chili powders with high pungent properties, thermal treatment should not be applied, however high microbial loads and enzyme activities then cannot be excluded. Considering these results and the findings of a former study, it can be concluded that blanching the whole fresh chili pods at 90 and 100°C for 5 minutes, respectively, yield moderate pungent chili powders with low microbial load and bright colour characteristics [Schweiggert Ute, Schieber Andreas and Carle Reinhold, Effects of blanching and storage on capsaicinoid stability and peroxidase activity of hot chili peppers (Capsicum frutescens L.), Innov Food Sci Emerg Technol, 2006, 7(3), 217-224].

Therapeutics

Honey prevents bacterial adherence to intestinal epithelial cells

In recent times, oral administration of honey to treat and protect against gastrointestinal infection such as gastritis, duodenitis and gastric ulceration caused by bacteria and rotavirus has been reported. The researchers at Department of Microbiology and Immunology, College of Medicine and Health Sciences, Sultan Qaboos University, Al-Khod, Oman evaluated the antimicrobial effect and the ability of honey to prevent Salmonella interitidis adhering to intestinal epithelial cells in vitro. Antimicrobial activity was demonstrated. Bacterial adherence was assayed using S. interitidis cells that had been incubated first with honey and then with the intestinal epithelial cells. Results showed that honey at dilutions up to 1:8 reduced bacterial adherence from 25.6±6.5 (control) to 6.7±3.3 bacteria per epithelial cell (P<0.001).

This is the first report of the ability of honey to prevent bacterial adherence in vitro. The findings demonstrated that the prevention of bacterial adherence caused by honey was through effect on bacteria, rather than epithelial cells. However, the fraction of the honey involved and the mechanism by which it inhibits bacterial adherence to epithelial cells are not known [Alnaqdy Adel, Al-Jabri Ali, Mahrooqi Zahra Al, Nzeako Basil and Nsanze Herbert, Inhibition effect of honey on the adherence of Salmonella to intestinal epithelial cells in vitro, Int J Food Microbiol, 2005, 103(3), 347-351].