A PRELIMINARY STUDY ON THE PROPER MATURITY AND THE STORAGE CONDITION OF CHILLI

By

KOMATHY - BALARATNAM.

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Buttala.

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Approved by

Dr. R.S.Wilson Wijeratnam,
Manager,
Post Harvest Technology Group,
Ceylon Institute of Scientific
and Industrial Reach,
Colombo 7, Sri Lanka.
Date: 22/10/96

Dr.K.K.D.S.Ranaweera,
Programme Co-odinator/
Food Science and Technology,
Actg. Head/Physical Science
Uva Campus,
Sabaragamuwa University of
Sri Lanka,
Buttala.
Date: 23/10-96

AFFECTIONATELY DEDICATED TO
MY LATE FATHER AND
EVERLOVING MOTHER,
BROTHERS AND
TEACHERS

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ABSTRACT

Proper maturity of the chilli (*Capsicum annum*) can be decided by various factors like colour formation and pungency level.

Studies were conducted to determine the proper conditions for storage of chillies and the proper maturity level of chillies by determining the pigment content and degree of pungency. These studies were at the CISIR Post Harvest Technology division of Food and Technology section.

Paprika powder and pericarp of pods were used for bio-chemical analysis. The total pigments and degree of pungency of the different samples chilies under various storage conditions were determined.

It was observed that, samples stored in poly sacs contained more pigments than others, and even the samples stored in the same conditions for 5 months contained a high level of pungency.

Chilies containing a low level of moisture (12.31 %) were capable of preventing the microbial growth. Thus these chilies can be stored for longer periods without any treatment and they contain a considerable amount of ash also.

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CHAPTER 1

INTRODUCTION

Common name	Chilli
Family	Solanaceae
Genus	Capsicum
Spices	annum
Botanical name	*Capsicum annum*.
Other names	Red pepper, Sweet pepper, Bell pepper, Cherry pepper, Paprika, Pimento, Long pepper, etc.

Chillies are the dried ripe red fruits of the genus capsicum. Capsicum fruits in different forms are popular food additives in many parts of the developed and developing countries of the world. The paprika that evolved in the temperate regions, is widely used as a table spice, as well as in the large but distributed meat processing industries and in the large organized processed food industries.

The dry powder of red pepper fruits has been used as a spice all over the world and also as medicine. This additive is valued principally for the brilliant red colour, which it gives to pale foods and also for its delicate aroma. *In* the tropical and subtropical regions, chillies are highly variable in sizes and shapes, as well as in the valued sensory quality of pungency and secondarily in red to orange colour, and

characteristic aroma in some species.

The chilli - varieties stimulating highly pungent flavour, in fresh and dried forms make an economic additive in daily use livening up the balance cereal diets of the developing countries. The bright red colour which obviously attracted the early gatherers of food in their adventure of eating, was also one of the natural pigments, the analysis of which opened up research in organic chemistry in the early 19th century. Though carotene and leaf xanthophylls were isolated around 1830, with the discovery of T. S. Wett's chromatography technique, it came to be known that the plant pigments were a whole series of related compounds, carotenoids.

Colour is one of the important quality attributes in this spice trade and the degree of pungency in dried chillies and in the extracts prepared from these spices also is an important determinant of the value and end uses of the product. The colour and pungency of red peppers largely determine the price that a producer receives. Several factors affect both of these criteria of quality. Colour retention is affected by the stage of ripeness at harvest and by addition of the antioxidant BHA to the dry ground products.

Thus this report mostly contains information about chilli and experiments on determination of pungency level, moisture content, total ash and total pigments and related laboratory

work which we have carried out.

OBJECTIVE OF THE STUDY

The objective of our study was to determine the suitable maturity stage for harvesting the chilli, and the proper storage conditions for storage of chillies using various indices such as,

i. Total pigments content

ii. The degree of pungency, and

iii. The total ash and moisture content of the dried chilli.

CHAPTER 2

LITERATURE REVIEW

2.1. HISTORY OF THE CAPSICUM

At the time of Columbus's discovery of the new world in 1492, Capsicum was widely grown and used in the Caribbean, south and Central America and Mexico (PURSEGLOVE J.W. et al. 1958). It was introduce into Europe in the 15th century. Now it widely distributed throughout most tropical and sub tropical areas (TINDALL 1983, LINCOLN C.PEIRCE 1987).

2.2. USES

Chillies are consumed in fresh, dried or processed form as table vegetable or spice (LINCOLN C.PEIRCE 1987). Green chillies are cooked with meat, pulses and in vegetables to improve the taste of these dishes (MINISTRY OF AGRICULTURE 1960). Also they are extensively pickled in salt and vinegar. Colour and flavour extracts are used in both the food and feed industries, example, ginger beer, hot sauces and poultry feed.

In the Philippines, the shoot tips are cooked and used as condiment or vegetable. Sweet non-pungent capsicum are widely used in the immature, green-mature or mature-mixed colours

stage as a vegetable, especially in the temperate zones, because of their ability to raise the body temperature, producing perspiration and there by causing the surrounding oppressive are to seem cool by comparison. Likewise by stimulating the flow of saliva and the gastric juices they may over come the loss of appetite and aid in digestion.

Besides the food processing industries chillies are used by a large number of institutions such as restaurants, hotels, hospitals, schools, canteens and armed forces.

Chillies may use as a medicine also. They are stomachic, stimulant and astringent. The Malaysians use chillies to prevent vomiting and to cure dyspepsia, diarrhoea and cholera.

A red viscous fatty oil has been isolated from chillies. On steam distillation, they yield a volatile oil (MINISTRY OF AGRICULTURE 1960, J.MCLEOD 1953, G.M.HOCHEINY AUBURN et..al 1969).

2.3. PROPERTIES OF CHILLI

2.3.1. Pigments of the chilli

Colour is one of the important quality attributes in this spice trade. Mature fruits are rich in pigments (LINCOLN C.PEIRCE 1987). The red colour of chillies are mainly due to the carotenoid pigments like capsanthin, capsorubin,

zeaxanthin, violaxanthin, cryptoxanthin, - carotene etc. Nearly 37 pigments have been isolated from capsicum. Out of these only 21 pigments are identified. These pigments are present in chillies in both the esterified forms as well as in non esterified forms (LASZIO BILICZKY and FERENC CSISZAR 1978). Capsanthin is the major pigment of chillies, consisting about 35% of the total pigments. The main contributors of red colour to the chillies, are the two keto carotenoids capsanthin and capsorubin. These are present in greatest amount in the first harvest of chillies, but decrease in subsequent harvest, wherein carotene and cryptoxanthin pigments contribute to the colour of the chillies (DANIEL J.CANTLITTE and P.GREDWIN 1981).

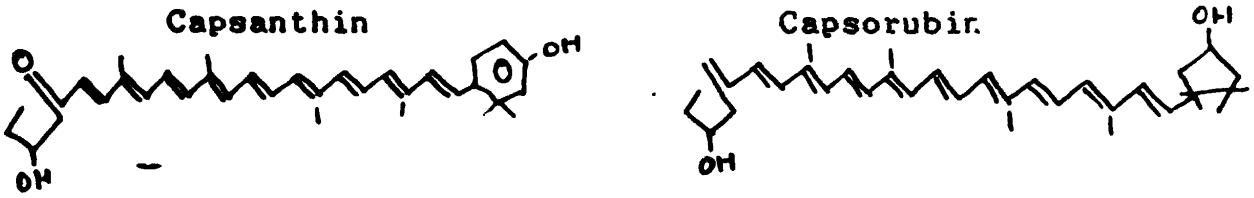


Fig 1. The molecular structure of the capsanthin and capsorubin pigments (M.N.KRISHNAMURTHY and C.P.NATARAJA 1970).

Carotenoid destruction is one of the main reaction affecting the deterioration of chilli during drying (J.G.LEASE and E.J.LEASE 1965). For the colour retention of dried chilli low temperature was proven to be desirable. Red peppers generally must be completely red to be acceptable for processing. This requires a long growing season and an extended harvest period. It would be economically advantageous to growers to have the fruit ripen earlier and

over a short time for a single harvest (F.H.M.RAHMAN et..al 1978). Ethephon has been used with varying success to hasten ripening of red peppers. Success of ethephon treatment has been primarily dependent on the environment (C.E.C.LORD et..al 1958).

Preservation of the attractive red colour of chillies during storage has been a problem. Most of the earlier researches on the colour deterioration have been confined to the studies on chillies in the ground form. Very little information is available on the stability of colour in whole chillies during storage (DONG - SUNLEE and HYUN - KUKIM 1989).

2.3.2. The pungency level of the chilli

The pungent principle of red pepper fruits are known as a compound group called capsaicinoids (alkaloids) and are found in variable quantities (0.01 - 1.0% of dry weight) in the cross-walls and placental tissue (LINCOLN C.PERICE 1987). Capsaicinoid is acid amides of vanillylamine and C_8 to C_{11} branched chain fatty acids (A.S.L.TIRIMANNA 1958).

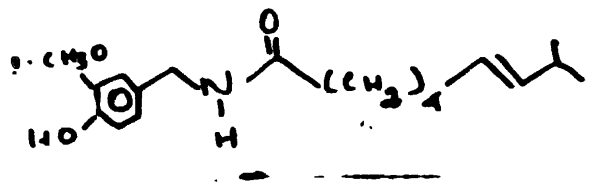


Fig 2. The structure of capsaicin (A.B.WOOD 1987).

There is a remarkable variation in the pungency of different varieties of capsicum and this investigation

describes a method for the determination of the total capsaicin content in the fruits of capsicum species. The extraction procedure is based on a method by which phenolic interference is reduced to a minimum by selective solubility (RESEARCH INSTITUTE FOR FOOD SCIENCE, KUOTO 1975).

Traditionally, organoleptic methods have been used for assessing their pungency, but such methods are subjective yield results with a large variance. Chemical determination of the concentrations of the substances responsible for the pungency, provides a more objective approach (J.G.LEASE and E.J.LEASE 1975). A useful spectra photometric method was developed in the early 1960s for the determination of total capsaicinoids in chillies, but it involves a laborious clean-up procedure and gives no information on the relative proportions of the individual capsaicinoids, which differ some what in their pungency. More recently HPLC methods, not requiring a clean-up, have been reported for the determination of individual and total capsaiciniods, and these have found widespread application in the quality assessment of chilli products.

2.3.3. Compositions of chilli

Table 1: The Nutritive value (compositions) of 100g chilli.

COMPOSITIONS	GREEN CHILLIES	RED CHILLIES	LEAVE

Water (ml)	86	87	82
Calories	48	45	53
Protein (g)	2	2	5.8
Fat (g)	0.8	0.8	1
Carbohydrate (g)	10	9	8
Fiber (g)	2.6	1.7	1.9
Calcium (mg)	29	11	246
Phosphorous (mg)	61	47	56
Iron (mg)	2.6	0.9	1.4
-carotenes (IU)	180	4770	6210
Thiamine (mg)	0.12	0.09	0.4
Riboflavin (mg)	0.15	0.12	0.3
Niacin (mg)	2.2	0.4	1.2
Vitamin C (mg)	140	86	68

Source from: H. D. Tindall's Vegetables in the tropics.

2.3.4. An antifungal compound of chilli

Capsidiol, an antifungal compound produced by the fruit of sweet peppers in response to inoculation with fungi, may have importance in the natural resistance of the plant to fungal disease. Capsidiol is optically active and has the

molecular constitution $C_{18}H_{24}O_2$ as established by elemental analysis and high resolution mall spectrometry (E.W.BWARD & A.STOESSL 1972, C.H.UNWIN 1973).

2.3.5. The lipase inhibitors of chilli

The lipase inhibitors of green capsicum inhibited both pancreatic and rice bran lipase where as the mode of these inhibition seems to be different. The preparation was much more effective on pancreatic lipase compared with rice bran lipase. In a very low concentration, the preparation showed accelerating effects on pancreatic lipase activity (HOON KIM 1958).

2.4. PRODUCTION AND INTERNATIONAL TRADE

World production of capsicum is estimated at 9.1 million tonne from 1.1 million ha. These figures, however, do not include production for home consumption and production for dried fruits, which constitute a significant part of the productibn in Asia. Regional statistics estimate production for Asia alone at 8 million tonne from 1.6 million ha, with India, China, Indonesia and Korea having the largest areas in production. Although Thailend has been a major supplier of capsicum in the region, its imports have exceeded exports in recent years. Malaysia exports a large volume of fresh capsicum to Singapore, but imports dried capsicum as well from India, China and korea (LINCOLN C.PEIRCE 1987. A.SIVA RAMA

PRASAD 1977).

Table 2: World production and trade of chillies .

Source form: A. Siva Rama Prasad's Marketing of chillies for exports.

MAJOR PRODUCTION '000tonnes.	1950	1960	1965	1970	1975
India	351	419	383	450	500
Thailand	-	47	74	60	65
Japan	-	-	7	4	5
Mexico	-	-	21	22	25
burma	-	-	17	18	20
MAJOR EXPORTS in tonnes					
Japan	813	3353	4092	4000	4000
China	1270	1829	3150	2000	2000
Thailand	6198	5029	1575	2500	2500
Mexico	1218	1727	2743	2000	2000
Indonesia	-	2083	508	1000	1000

MAJOR IMPORTS in tonnes					
Ceylon	-	8819	14129	20000	20000
USA	-	3571	4822	7000	9000

2.5. VARIETIES

These varieties are recommended by the Department of Agriculture viz, MI-1, MI-2 and Santaka (A STUDIO TIMES PUBLICATION 1978).

The MI-1 variety has been the backbone of the local chilli industry for the past decade. Among its singular attributes is its capacity to produce high yields of 15-25 cwt of dried chilli per acre under irrigation and 4-8 cwt under purely rainfed conditions and the desirable qualities of its pod scare 4-5 inches long, blood-red in colour and of medium pungency. Its only weakness is a susceptibility to the leaf-curl disease.

MI-2 is a mutant strain of the MI-1 variety displaying a higher level of resistance to the leaf-curl disease. The yield is comparable with MI-1, the pods are long but a little narrower and more pungent.

Santaka is an introduction from Japan. It produces a

smaller chilli but its quality and pungency are just as good as MI-1 or MI-2. The distinctive feature of santaka is that the pods do not hang down. On the contrary they stick up. Well irrigated and under dry climatic conditions yields of 15-20 cwt per acre may be taken. It also reported some other varieties like KA-2, Kochichi etc (O.J.OLIVIER &L.GINSBERG 1974).

2.6. BOTANICAL INFORMATION

An annual or short-lived perennial herb. Upto 1.5 m in height (LINCOLN C.PEIRCE 1987).

2.6.1. Roots: A well developed tap root, often with many lateral roots.

2.6.2. Stems: Branched, erect or semi prostrate, fleshy, often woody at the base, round or slightly angular, growth normally indeterminate.

2.6.3. Leaves: Alternate simple, ovate to lanceolate. Margins entire, tip pointed, variable in size. Upto 12 cm long, 7.5 cm wide.

2.6.4. Flowers: Single, sepals 5, companulate, some times white-green. Upto 15 mm in diameter. Anthers 5 or 6, style

with capitate stigma.

2.6.5. Fruit: A many-seeded berry, hollow, rectangular to long, 1-4 cm in diameter.

2.6.6. Seed: Flattened and kidney-shaped. 3-5 mm in length, pale yellow, 100 seeds weigh approximately 5.5g (TINDALL 1983).

2.6.7. Cytology and genetics: All the cultivated species of chilli are diploid (2n = 24). The studies show some genetic information about chilli as follows,

* The red colour of the mature fruit is a single dominant to yellow.
* The pendant position of the fruit is dominant to erect.
* The deciduous ripe fruit is dominant to non-deciduous.
* The pungent fruit is dominant to mild all in a simple 3:1 ratio (J.W.PURSEGLOVE et..al 1958).

2.6.8 Growth and development: Seeds germinate in 6-21 days after sowing and continuous flowering begins at 60 - 90 days after sowing. Flowers are open for 2-3 days. Although normally considered a self- pollinated crop, out crossing upto 91% may occur, depending on bee activity and heterostyly. Under normal circumstances calcium, 40 -50 % of the flowers set fruit. Fruits begin to mature at 4-5 weeks after flowering, and can be picked in sequences of 5-7 days. The

peak harvest period is 4-7 months after sowing, but perennial growth continues in the absence of frost or disease (Tindall 1983, Lincoln C.Peirce 1987).

2.7. ECOLOGY

Chillies are considered to be warm season, day-neutral plants, although certain forms may show a photoperiodic reaction. The vegetative cycle may be hastened by imposing certain photoperiod, but reports in the literature are conflicting. Chillies tend to tolerate shade conditions upto 45% of prevailing solar radiation, although shade may delay flowering. They grow best on well-drained loamy soils at pH 5.5-6.8. They grow at a wide range of altitudes, with rainfall between 600 - 1200 mm. Severe flooding or drought is injurious to most cultivars. Seeds germinate best at 25-30°C. Optimal temperatures for productivity are between 18 - 30°C. Cooler night temperatures down to 15°C favour fruit setting, although flowering will be delayed as temperatures drop below 25°C. Flower buds will usually abort rather than develop to maturity if night temperatures reach 30°C. Pollen viability is significantly reduced at temperatures above 30°C and below 15°C (Tindall 1983, Lincoln C.Peirce 1987).

2.8. PROPAGATION AND PLANTING

Chillies are propagated by seed. Seeds should be harvested from mature fresh fruits after 2 weeks of post

harvest ripening. Seeds remain viable for 2-3 years without special conservation methods if kept dry, but they rapidly lose viability if improperly stored at high temperature or humidity. Seed dormancy may occur to a limited extent, especially if seed is harvested from under-ripe fruits. Seed priming treatment are sometimes effective in invigorating germination. If helps to prevent fungal disease. It can be treated with captan 80% WP for 6 g/Kg of seeds or thiram 80% WP for 4 g/Kg of seeds (LINCOLN C.PEIRCE 1987).

To plant 1 hectare, 200 - 800 g of seed is needed depending on plant density. In nursery beds or flats, and transplanted bare-rooted to the field. Seed-beds are usually covered with straw, leaves or protective tunnels. For better production, seedlings should be transferred to seedling pots (plastic pods, paper cups, banana leaf-rolls etc.), when the cotyledons are fully expanded. In the nursery, starter fertilizer is recommended at 2 weeks intervals. Transplants are planted out in the field at the 8-10 true leaf stage, usually 30 - 40 days after sowing. Hardy transplants can be produced by restricting water and removing shade production, starting 4-7 days before transplanting. Transplanting should be done during cloudy days or in the late afternoon and should be followed immediately by irrigation. Direct sowing in the field is practiced to a limited extent. Plant populations may range from 10,000 - 130,000 plants per ha, depending on the region, management practices, and cultivar.

Chillies are well adapted to sole cropping and inter-cropping systems. In Asia, production is usually practiced on small-scale farms on plots of 0.1 - 0.5 ha, although total acreage may be substantial. Chillies are often relay-cropped with tomatoes, shallots, onions, garlic, okra, Brussica spp., and pulses. They also grow well among newly established perennial crops (LINCOLN C.PEIRCE 1987, TINDALL 1983).

2.9. HUSBANDRY

Chillies thrive best if supplied with liberal quantities of organic matter and a balance of mineral fertilizers. A reasonable recommendation is to supply 10-20 tonne/ha of organic amendments. General nutrient requirements are 130 Kg/ha of N, 80 kg/ha of P and 110 Kg/ha of K. They split into basal plus side dressings at 3-4 weeks intervals, beginning at first flowering. Boron at the rate of 10 Kg/ha is also recommended. Nutrient availability is subject to soil type and environmental conditions, so local recommendations vary.

In Asia manual weeding is the common practice for weed control. It is most critical at the reproductive phase. Organic or plastic mulches are very effective for weed control, and reflective mulches help to minimize insect vectors of plant viruses (TINDALL 1983, LINCOLN C.PEIRCE 1987).

2.10. DISEASE AND PEST

Viruses cause the most serious damage. The most obvious method of control is to use resistant cultivars. Unfortunately only few cultivars with resistances are known. Cucumber mosaic virus, chilli veinal mottle virus, potato virus Y and a complex of the tobacco virus group are the most important in asia.

Anthracnose caused by *colletotrichum* spp. is a major problem of ripened fruits and is best controlled by proper crop management to minimize the source of inoculum via seeds or host debris. Partial resistance has been found. *Phytophthora* blight and crown rot (*Phytophthora capsici*), *Cercospora* leaf-spot (*Cercospora capsici*), bacterial spot (*Xanthomonas campestris*) and bacterial wilt (*Pseudomonas solanacearum*) are other important diseases and are best controlled by integrated pest management, including resistant cultivars that may be available (L.R.SAHA & H.B.SINGH 1988).

The major pest are thrips, aphids, mites, bollworms (*Heliothis* spp.), and fruit flies (*Dacus* spp.). As most of these are poly-phagons pests, control is difficult. Resistances are not yet available, but field tolerance is observed in some cultivars. In appropriate pesticides and over-use of pesticides often augment the pest problems in chillies. Integrated crop management is suggested to overcome multiple pest and disease problems (LINCOLN C.PEIRCE 1987).

2.11. HARVESTING

Chillies are ready for harvest 3-6 weeks after flowering depending on the fruit maturity desired. Green fruits are mature when firm, if gently squeezed they make a characteristic popping sound. Harvesting is done by hand or with the aid of a small knife. They are often harvested at the green mature stage, although some times they are harvested red (LINCOLN C.PEIRCE 1987).

2.12. YIELD

Chilli yields vary widely from 1.5 - 18 tonne/ha, particularly in Asia. Maximum dry weight recovery of chilli is near 25-30%. Yields under irrigated conditions tend to be higher than for rainfed production, but vary with other management practices (LINCOLN C.PEIRCE 1987).

2.13. HANDLING AFTER HARVEST

Unless sold for the fresh market, chillies are sun-dried in most of Asia. Sun-drying usually takes place in a vacant field or roadside, on mats or a well-swept area. In the sun, chillies will dry adequately in 10-20 days, with frequent turning of fruits. Steaming of chilli before being sun-dried is normally practiced in southern Thailand. It tends to improve the appearance, making dried fruits look glossy Marketing is usually conducted from wholesale to retail

markets, but there are also many informal marketing channels. Dried chillies may be stored for months in wholesale warehouses to supply year-round demands. Fresh fruits can be stored for up to 5 weeks at 4°C and 95% humidity (O.J.OLIVIER & L.GINSBERG 1974, H.D.TINDALL 1983, LINCOLN C.PERICE 1987, J.W.AURSEGLOVE et..al. 1958).

CHAPTER 3

MATERIALS AND METHODS

3.1. MATERIALS

Dried chillies were obtained from farmers in the Anuradhapura district. Randomly selected samples from different farmers and from different storage periods (one month storage, two months storage, etc.) were transported to the Post Harvest Technology laboratory at the CISIR, and stored for further analyses.

3.2. PREPARATION OF SAMPLE.

3.2.1. Prepare the sample to determine the total pigments.

Stored chillies were washed and removed stalks, seeds etc. and only pericarps were cut into small pieces.

3.2.2. Preparation of chilli powder.

Washed and cleaned stored chillies were dried and ground using grinder. It was sieved to remove large particals.

3.3. SPECIFICATIONS FOR DRIED WHOLE CHILLIES AFTER THREE MONTHS STORAGE

Methodology

500 grams of dried chillies were divided according to the SLS 853, 1989 standards of Sri Lanka. (See appendix 2).

3.4. THE ESTIMATION OF TOTAL PIGMENTS IN CHILLI AFTER STORAGE

3.4.1. Plotting the standard graph.

Reagent: Potassium di cromate ($K_2Cr_2O_7$) powder.

Methodology

5 different 50 ml $K_2Cr_2O_7$ solution was used to get calorimetric readings the standard graph was drawn.

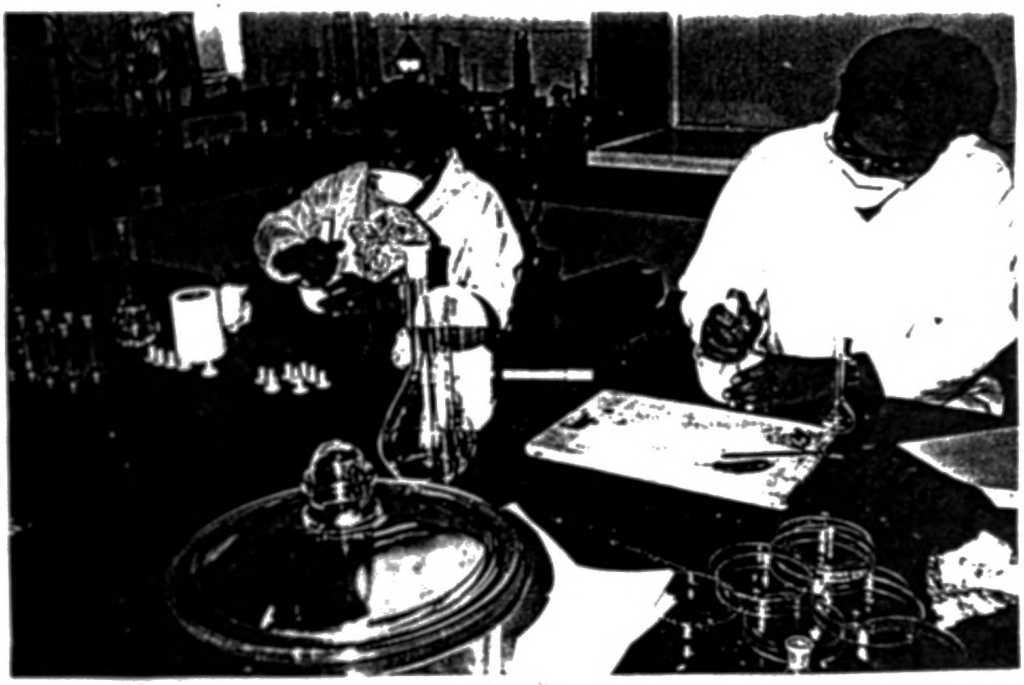
3.4.2. Determination of the total pigment in chilli

Reagents: Petroleum ether-acetone solution

Pure sand.

Methodology

0.25 g of sample which was described in the section 3.2.1., was weighed and ground with pure sand using mortar and pestle. The pigments of chilli was extracted using 2:3 petroleum ether-acetone solution, and decanted into a 100 ml volumetric flask upto all fat soluble pigments were taken out, and the volume was adjusted. Whole flask was covered or wrapped with aluminum foil until the colorimetric readings were taken out.



Experimental working of total pigment

3.5. DETERMINATION OF THE PUNGENCY OF DRIED CHILLI AFTER STORAGE

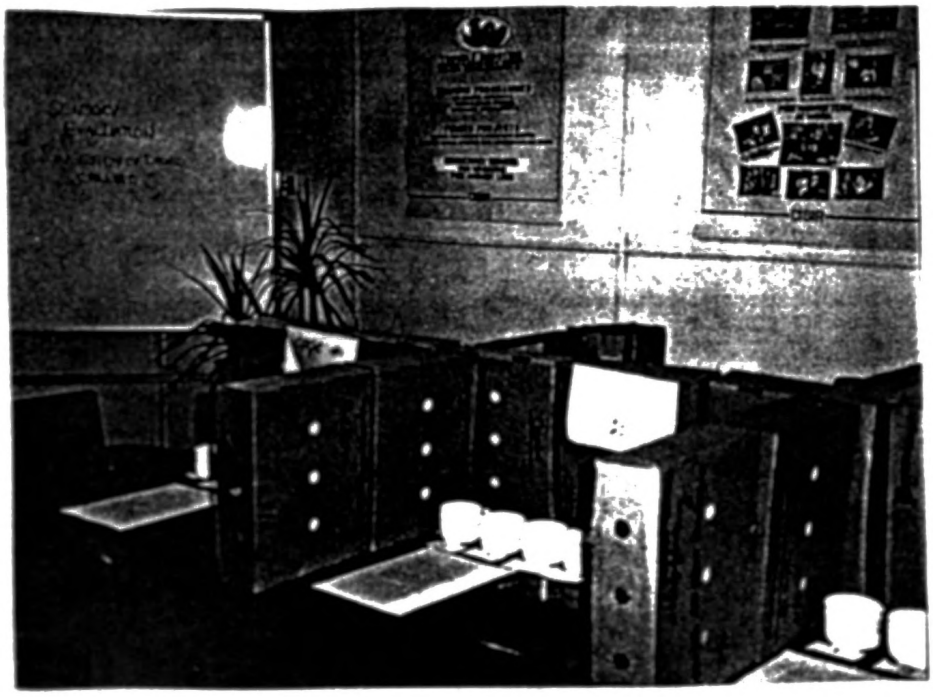
Regents: 95% ethyl alcohol

5% sucrose solution

Methodology

0.1 g of samples, described in section 3.2.2., cold extraction was carried out with 50 ml 95% ethyl alcohol for about 16 to 20 hours with occasional shaking, and it was filtered. According to the schedule B (see appendix 4.1), little extraction was diluted with 5% sucrose solution upto 50 ml. With in the range of pungency threshold about 5 different dilutions were prepared for tasting. For tasting about 5 ml aliquots of solution

were swallowed at a time in the cup from each dilution and before first tasting in between each tasting, mouth was rinsed weigh 90 - 100°F warm water. The time interval between sample was 5 min.



Arranged sensory room.

3.6. DETERMINATION OF MOISTURE CONTENT OF CHILLI AFTER STORAGE

Reagent: Toluene.

Methodology

16.2456 g of stored chillies were cut into small pieces and transfer to the distillation flask with toluene enough to cover the sample completely and the apparatus was fixed. It was heated until the receiver's reading was stabled (about 3 hours).

3.7. DETERMINATION OF TOTAL ASH IN CHILLI AFTER STORAGE

Reagent: Ethanol.

Methodology

2 ml ethanol was added to 2.1166 g cut pieces of chilli and it was ignited. Then it was heated on a hot plate until char the pieces. It was ignited again in the furnace at 500 +/- 250°C for 2 hours. Then the ash was cooled and wetted with several drops of water, and evaporated to dryness. It was heated again in the furnace for a further 1 hour at 550 +/- 250°C. Then it was removed to the desiccator to cool and weighed with out delay.

One of the important thing that all this experiments was done under total saturation of the experimental environment. It was determine according to the Psychometric chart. It is attached at appendix 1.

CHAPTER 4

RESULT AND DISCUSSION

4.1. SPECIFICATION FOR DRIED WHOLE CHILLIES.

4.1.1. Results

Table 3. Results of specification for dried whole chillies

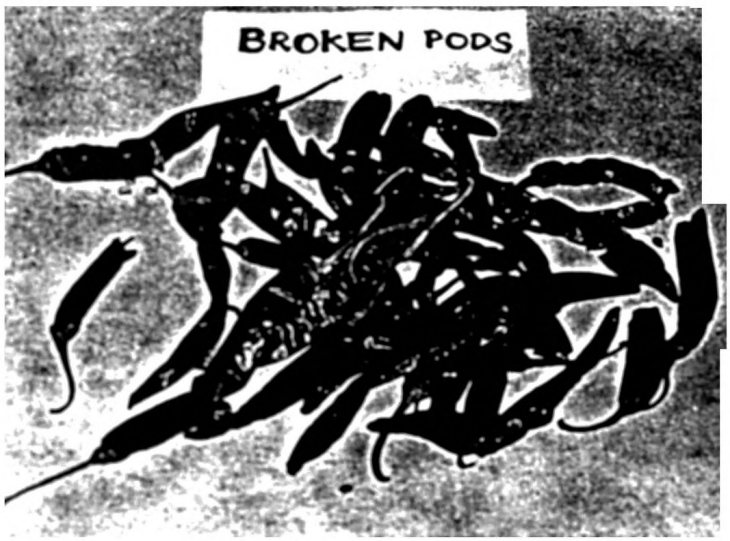
DIVISION OF MATERIALS	WEIGHT in grams / 500 grams	PERCENTAGE %
Good quality	241.8	47.34
Discoloured pods	148.7	29.11
Damaged pods	53.9	10.55
Pods without stalks	19.6	3.84
Broken pods	16.8	3.29
Extraneous matters	7.3	1.43
Loose seeds	5.8	1.14

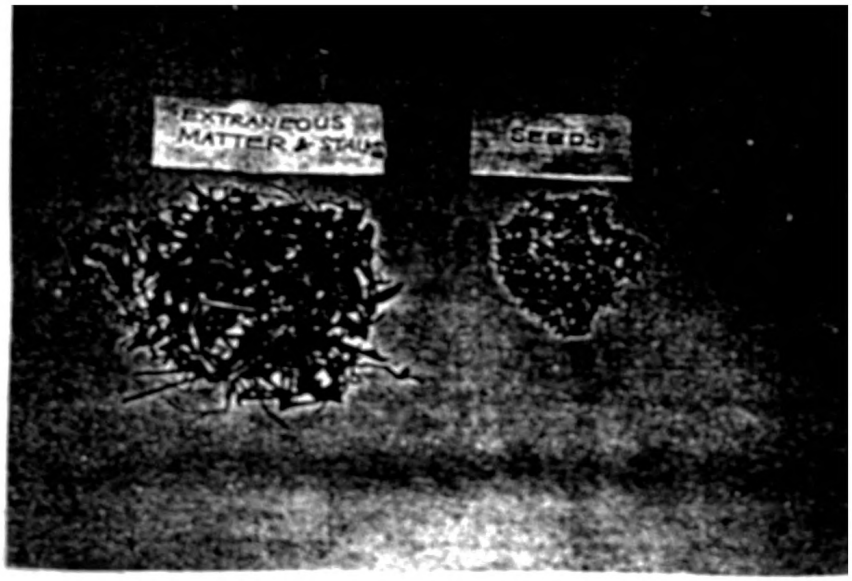
GOOD QUALITY

DISCOLOURED
PODS

DAMAGED PODS
[DISEASE / PESTS / ETC]

PODS
WITHOUT
STALKS





4.1.2. Calculation

% of particular division = w/W x 100

where, w - weight of particular division (g)

W - whole weight of material (g).

4.1.3. Discussion

Pure sample of chilli would not be observed. Good pods chilli itself contained a mixture of discoloured pods, damaged pods, pods without stalks, broken pods, extraneous matters and loose seeds etc.. Various factors are responsible for this variation, such as micro organisms, pest, various diseases, excessive drying, chilling, physiological damages and bad handling etc.. are some of them.

4.2 - TOTAL PIGMENTS IN CHILLI

4.2.1. Standard graph

Table 4. Result for standard graph.

$K_2Cr_2O_7$ solution (g/50 ml)	Reading of calorimeter (in units)
0.0202	0.592
0.0301	0.888
0.0403	1.200
0.0502	1.470
0.0601	1.760

The standard graph was attached in appendix 3.

4.2.2. Percentage of pigment in chilli

Table 5. Result of total pigments in chilli.

STORAGE SAMPLE 0.25 g/50ml & 10% diluted	SPECTO PHOTOMETRIC READINGS	VALUE OF TOTAL PIGMENTS	% OF TOTAL PIGMENTS
9cm crate	0.383	0.1275	51
18cm crate	0.467	0.175	70
25cm crate	0.413	0.136	54.4
Poly sac	0.515	0.18	72
Jute bag	0.493	0.165	66
Sun dried in ground	0.291	0.098	39.2
Pressed	0.380	0.128	51.2
Citric acid (1%, 1 min, 65°C)	0.364	0.124	49.6
NaOH (3.5%, 20sec)	0.319	0.1175	47
$NaHCO_3$ (0.05%, 1 min, 65°C)	0.253	0.0825	33
Blanched (65°C, 1 min)	0.295	0.1	40
No treatment	0.294	0.099	39.6

Maturity stage 1	0.052	0.018	7.2
Maturity stage 2	0.077	0.025	10
Maturity stage 3	0.132	0.037	14.8
Maturity stage 4	0.193	0.065	26
Maturity stage 5	0.242	0.076	30.4

4.2.3. Discussion

- The extraction contain glassware should be catered to prevent light. The decomposition of this pigments, is affected by atmospheric oxygen and ambient temperature. The reaction of pigment decomposition is logarithmic, and is the molt vigorous in the first period of storage. During the first 30 days of storage over 60% of the total decomposed amount is actually decomposed. On applying various antioxidants, the decomposition process can be retarded. Treatment of powdered paprika with sustan 1-F saved about 5% of pigments. On using 0.02% of santoquin as stabilizing agent, already 20% of pigments could be saved.(LASZIO BILICZKY AND FERENC CSISZAR 1982)
- Experimental samples were already stored in various chemical as mentioned.
- Sand helps to easy grinding.

4.3. THE DEGREE OF PUNGENCY IN CHILLI

4.3.1. Result

The results observed by the panelist are shown in appendix 4.2., and converted into SHU using the table ASTA method 21 in schedule B which attach in appendix 4.1.

Table 6. Result of total pungency of chilli

SAMPLE	TOTAL PUNGENCY (SHU)
Farmer 1	37000
Farmer 2	45000
Farmer 3	50000
Farmer 4	50000
farmer 5	50000
Collector 1	40000
Collector 2 - 3 months	45000
5 months	50000
Collector 3 - 5 months	50000
low quality	40000

4.3.2. Discussion

- Feeling capacity of the panelist is different from panelist to panelist.
- The reduction of the capsaicin content during ripening and drying also may be cause the variation of pungency value.

- This series of observations should be done carefully without adding any unwanted chemicals or substance, because panelists taste themselves.

4.4. MOISTURE CONTENT OF CHILLI

4.4.1. Results

Water level of receiver is 2 ml.

Moisture content of chilli is 12.31%

4.4.2. Calculation.

Moisture content H = 100 v/m.

Here, v - volume of the water (ml)

m - mass of the test portion (g).

4.4.3. Discussion

- Before adding sample, the toluene was distilled to remove any moisture, and reduce any experimental error.
- A long enough copper wire extend through the condenser to help the water - toluene balance in receiver.
- Moisture content is one of the major factor that assist the growth of the micro organisms. Therefore low level of moisture content can prevent the microbial growth and can store the sample much more duration.

4.5. TOTAL ASH OF THE CHILLI

4.5.1. Result

Table 7. Result of total ash in chilli

SAMPLE	CRUCIBLE 1	CRUCIBLE 2	CRUCIBLE 3
Weight of empty crucible (g)	76.5290	81.1734	81.0456
Weight of crucible + sample (g)	78.6456	83.4042	83.0557
Final weight (g)	76.6353	81.2828	81.1414
Percentage of ash (%)	5.02	4.9	4.72

4.5.2. Calculation

Percentage of ash = w/W x 100 +/- 0.1489

Here, w - weight of ash (g)

W - weight of sample (g).

4.5.3. Discussion

* The final result is decided with average of above three and added for the standard derivation of +/-0.1489.
* During the experiment if the wetting shows the presence of carbon, repeat the wetting and heating until no specks of carbon are visible and ignite in the furnace for one hour after the disappearance of carbon. If carbon is

still visible leach the ash with hot water, filter through an ashless filter paper, wash the filter paper thoroughly, transfer the filter paper and contents to the ashing dish, dry and ignite in the furnace until the ash is white. Cool the dish, add the filtrate and evaporate it to dryness on the steam bath. Heat in the furnace again cool in a desiccator and weight as previously. Heat again in the furnace for one hour, cool and weigh. Repeat these operation until the difference in mass between two successive weighing is less than 0.002 g.

CONCLUSION

Various sample of chillies are used to analysis but which are not pure. They contain extraneous matters such as stem, dried leaves, stones, stalks, small sticks etc., and loose seeds, damaged discoloured pods etc.

After proper harvest, poly sacs are best to store the dried chillies. 18 cm crate also can use to store the chillies. Bad storage conditions cause the distraction of pigments.

The total pungency amount of chilli is between 37000 to 50000 SHU units, and the percentage of moisture in chilli is 12.31. The total ash in chilli is between the range of 4.67 to 4.972.

From these studies it was confirmed that the total pigment content and the degree of the pungency can help to determine the maturity level of the chilli cultivation.

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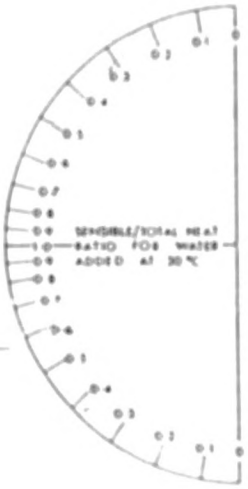
PSYCHROMETRIC CHART

BASED ON A BAROMETRIC PRESSURE OF 1013·25 mbar



APPENDIX 2

Terminology used in the Report

1. **Good quality:** The dried, ripe fruits of certain varieties of the species *Capsicum annum*. These fruits have a characteristic red colour and are either oblong, conical or small and round pots containing yellow seeds.

2. **Extraneous matter:** All matter other than pods of dried whole chillies. Calyx pieces and loose stalks are considered as extraneous matter.

3. **Discoloured pods:** The pods which have patches of brown, black or other colour or pods which are entirely of any one of there colours.

4. **Damaged pods:** The pods distinctly identified as having been visibly affected by pests, heat, water, disease or any other causative agent.

5. **Broken pods:** The pods which are broken or split during the process of handling.

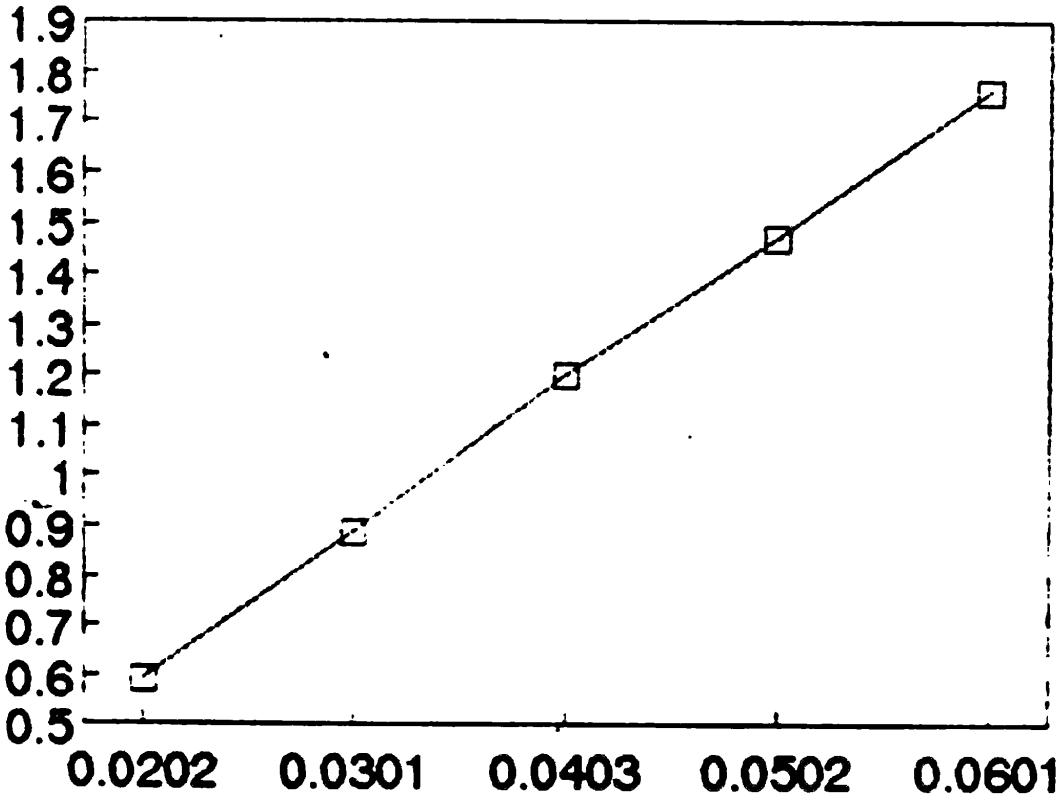
6. **Loose seeds:** The seeds which are not contained within the pod.

7. **Pods without stalks:** The pods which are not attached to their stalks.

Source: SLS 853: 1989. Standard book of Sri Lanka Definitions.

APPENDIX 3

STANDARD GRAPH



APPENDIX 4

4.1. SCHEDULE B OF THE ASTA ANALYTICAL METHOD

M UNITS	CHL (.1g/50 ml)
100	0.25
95	0.26
90	0.28
85	0.29
80	0.31
75	0.33
70	0.35
65	0.38
60	0.42
55	0.45
50	0.5
45	0.55
40	0.63
37	0.68
34	0.74
31	0.8
28	0.89
26	0.96
25	1.0

4.2.

SCORE CARD FOR THRESHOLD TEST FOR

PUNGENCY IN CHILLI

Name ..... Date :..... Time :.....

Sample description :.....

Cage No :.....

INSTRUCTIONS:

Taste the samples in the following sequential order as increasing concentration.

Swallow slowly the whole quantity of the test sample.

Wait for few seconds to recognize pungency if any (aroma suggesting chilli should not be confused for pungency).

Take few sips of warm water and allow 5 minutes between samples.

Taste the samples in sequential order until you sense any pungency and then stop tasting.

Note: whether you sense the pungency of the tested samples as described below :-

Code No.	Can pungency be identified? Yes or No
1	.....
2	.....
3	.....
4	.....
5	.....
6	.....

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