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Preliminary studies on the bioactive phytochemicals in extract of Cape gooseberry (*Physalis Peruviana* L.) fruits and their Products

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Abstract
Cape gooseberry (*Physalis peruviana* L.) belongs to family Solanaceae and is reported to have health benefits because of its high antioxidants, vitamins, minerals and fiber (Puente *et al.*, 2011). A study was thus designed to find out the nutraceutical value of the fresh fruit as well as their processed products by identifying the bioactive phytochemicals in different extracts viz., aqueous extract (AEPP), methanolic extract (MEPP), ethanolic extract (EEPP) of the fresh fruit and two products viz., fresh fruit juice (FFPP) and squash (SQPP). The five samples were subjected to Fourier transform infrared (FT-IR) spectroscopy and spectra were obtained for each sample. The EEPP (Peak maximas recorded at 667.5, 877.3, 1043.7, 1084.7, 1326.5, 1382.8 and 1645.5 cm^{-1}) and SQPP (Peak maximas recorded at 692.5, 670.9, 1032, 1032.0 1240.5, 136.24, 1419.1 and 1639.9 cm^{-1}) showed the presence of maximum number of bioactive compounds as compared to the other samples. This was followed by MEPP (662, 1014.5, 1240.5, 1362.4, 1419.1 and 1644 cm^{-1}) & FFPP (663.1, 687.2, 1058.6, 1237.8, 1368.4 and 1636 cm^{-1}) while AEPP (668.5, 1015.8 and 1636.6 cm^{-1}) showed the minimum peaks. Among the products the SQPP and FFPP were highly correlated showing the presence of similar phytochemicals detected. AEPP was the least efficient method of extraction of the phytochemicals since it showed the minimum absorption maxima peaks indicating a smaller number of compounds extracted. All samples studied have shown a major absorption in the wavelength range of polyphenols (1700-600 cm^{-1}) thus indicating their potential antioxidant capacity.

Keywords: Phytochemicals, FT-IR, Cape goose berry (*Physalis peruviana* L).

1. Introduction
Free radicals have been regarded as a fundamental cause of several kinds of diseases, including aging, diabetes mellitus, coronary heart disease, inflammation, stroke, rheumatic disease, liver disorders, renal failure and cancer. Berries have been shown to provide significant health benefits because of their high antioxidants, vitamins, minerals and fiber. *Physalis peruviana* or Cape gooseberry is a highly underutilised fruit crop of family Solanaceae, which has potential value as a nutraceutical (Puente *et al.*, 2011; Dinan *et al.*, 2001 and Hassanien 2011) besides its nutritional value. Major bioactive compounds of *Physalis* spp., such as physalins (B, D and F) and glycosides (such as myricetin-3-*O*-neohesperidoside), have been shown to possess anticancer activities. Previous phytochemical studies have isolated a number of compounds from *Physalis peruviana* L, such as ticloidine, withanolides (Dinan *et al.*, 2001), phenolics, phytosterols (Hassanien 2011) etc.
Cape gooseberry is still considered an underutilised crop in India and exploitation of the crop for its antioxidant properties has not been studied. The present study has thus been undertaken to find out the presence of bioactive phytochemicals in different extracts of cape gooseberry (*Physalis peruviana* L.) in India, to evaluate different extraction processes on the basis of preliminary screening of the bioactive phytochemicals in the extracts, as well as two processed products (fresh fruit juice and squash) of cape gooseberry.

2. Materials and Methods
2.1 Biological material
Ripe fruits of Cape gooseberry were obtained from local growers at Katauli village, Kakori, Lucknow (UP) located in the north Indian plains during mid-May 2012. Intact fruits of uniform ripeness were carefully selected, washed and air dried. iron, magnesium, manganese, niacin, potassium, phosphorus, protein, riboflavin, selenium, silicon, sodium, thiamine, tin, zinc.

2.2 Extraction
Fresh fruits were processed for extraction of the bioactive molecules using standardized methods immediately after harvesting. Aqueous, methanolic and ethanolic extracts were prepared (Wu *et al.*, 2005) and subjected to fourier transform infrared spectroscopy for the detection of the bioactive biomolecules present in the extracts.

2.3 *Physalis* fruit juice and squash
Two formulations from ripe Cape gooseberry were prepared by adding 1.75kg sugar and 20 g citric acid to 1.0 litre water for the preparation of squash from 1 litre of fruit pulp. These were also subjected to FTIR spectroscopy (Nicolet^{TM} 6700 Thermo scientific USA) to detect the presence of the bioactive molecules.

3. Result and Discussion
The spectra obtained illustrate the various chemical constituents in different extract (Fig1). Ethanolic (EtOH) and the methanolic (MeOH) extracts have shown a significant bioactive phytochemical yield followed by aqueous (H_2O) extract. There is a correlative spectral distribution found among all the samples. The EEPP (Peak maximas recorded at 667.5, 877.3, 1043.7, 1084.7, 1326.5, 1382.8 , 1645.5, 2977.1 and 3353.1 cm^{-1}) Fig 1 & Table 1 and SQPP (Peak maximas recorded at 692.5, 670.9, 1032.0 1240.5, 1362.4, 1419.1, 1639.9 and 3281.6 cm^{-1}) Fig 2 & Table 1 showed the presence of maximum number of bioactive compounds as compared to the other samples. This was followed by MEPP (662, 1014.5, 1240.5, 1362.4, 1419.1 and 1644 cm $^{-1}$) Fig.1 & Table 1 & FFPP (663.1, 687.2, 1058.6, 1237.8, 1368.4 and 1636 cm $^{-1}$) while AEPP (668.5, 1015.8 and 1636.6 cm^{-1}) showed the minimum peaks (Fig 1). Among the products the SQPP and FFPP were highly correlated showing the presence of similar phytochemicals detected, which is understandable since the fresh fruit pulp is a major constituent of the squash. The peak in the range of 3001-3500 cm^{-1} obtained in all the samples corresponds to hydroxyl ($^{-}$OH) group (Meenambal *et al.*, 2012) and indicate presence of withanolides in the sample since these molecules are characterised by the presence of a large number of oxygen-containing functional groups (hydroxyls, ketones, epoxides ,cyclic ether) (Dinan *et al.*, 2001). The withanolides are also often subdivided on the basis of whether they possess a hydroxyl group at C-20. Bioactive molecules of significance in the spectral range of 1700-600 cm^{-1} have been detected in all the extracts and further indicate the presence of withanolides since these frequencies are characteristic of ether, carboxylic acids and esters. (Gorinstein *et al.*, 2010). All samples studied have shown a major absorption in the wavelength range of polyphenols (1700-600 cm^{-1}) thus indicating their potential nutraceutical value (Gorinstein *et al.*, 2010). AEPP was the least efficient method of extraction of the phytochemicals since it showed the minimum absorption maxima peaks indicating a smaller number of compounds extracted.

Since a major range of bioactive molecules detected in ethanolic extracts are detected even in the squash formulation it is thus, indicative that this formulation would provide all the bioactive constituents of significance from the *physalis* fruit and could be used as a herbal beverage possessing *per se* the biological activity of the withanolides as anti-tumor, immunosuppressive and hepato-protective agent. However, this needs to be put to further verification.

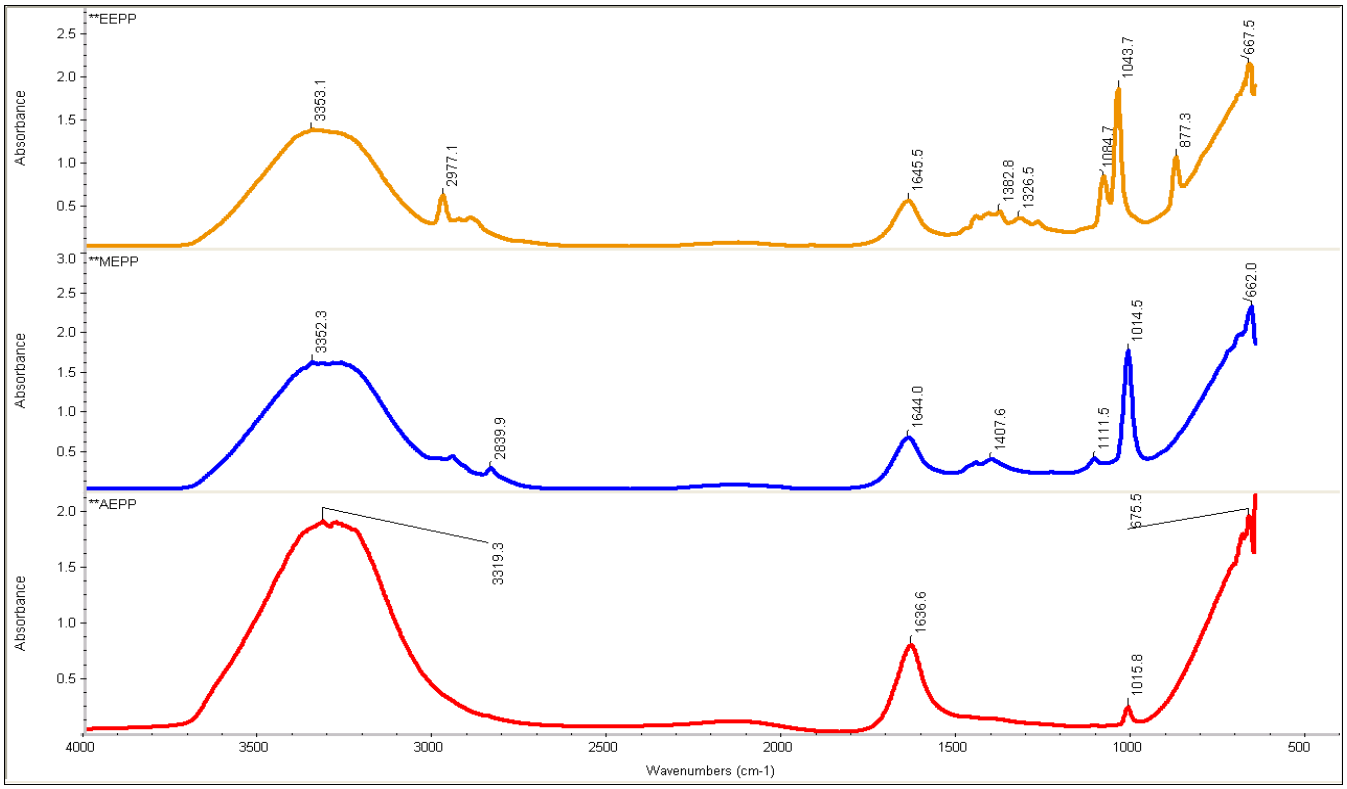

Fig 1: FT-IR absorbance spectrum of (a) Ethanolic [EEPP], (b) Methanolic [MEPP] and (c) Aqueous [AEPP] extract of *Physalis peruviana* L.

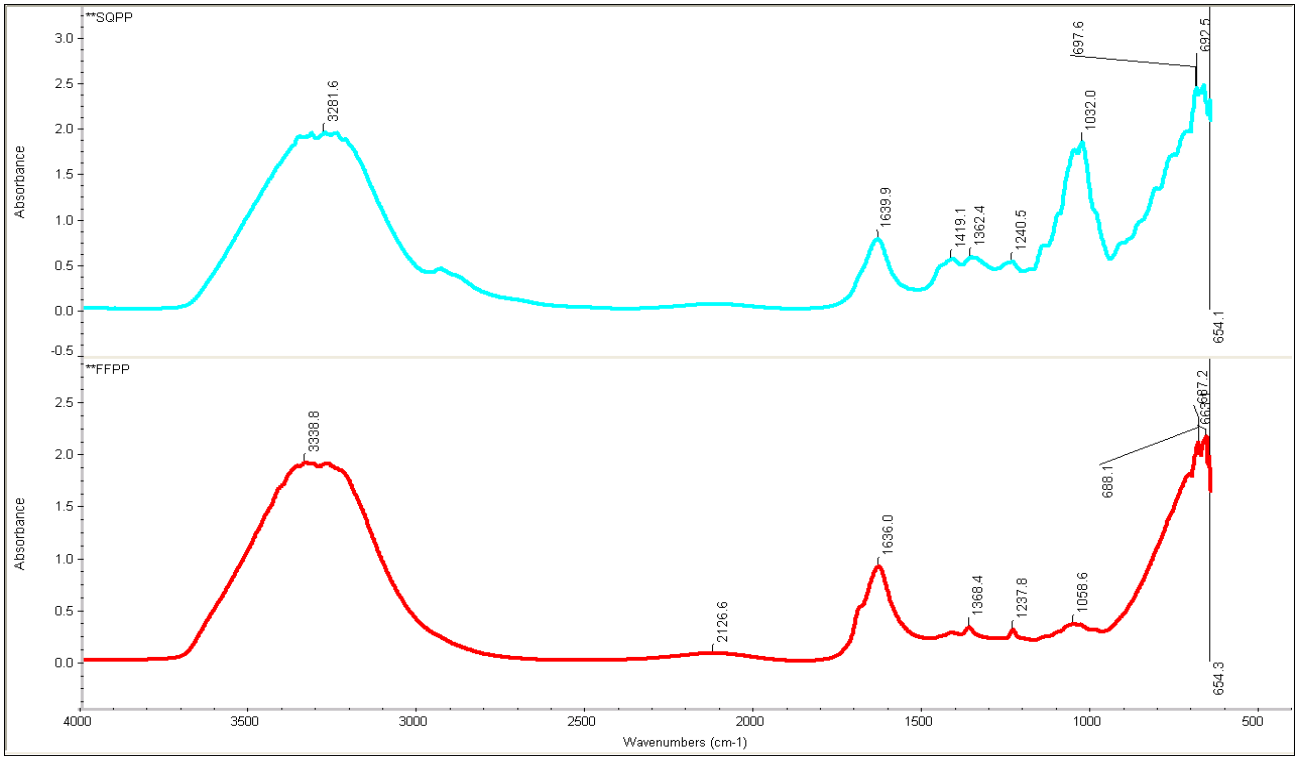

Fig 2: FT-IR absorbance spectrum of (a) Squash [SQPP] extract and (b) Fresh fruit juice [FFPP] of *Physalis peruviana* L.

Table 1: FT-IR spectral range of different extracts and products of Cape gooseberry (*Physalis peruviana* L.)

Range	EEPP	AEPP	SQPP	MEPP	FFPP
500-1000	667.5 877.3	668.5	692.5 670.9	662.0	663.1 687.2
1000-1500	1043.7 1084.7	1015.8	1032.0 1240.5 1362.4 1419.1	1014.5 1240.5 1362.4 1419.1	1058.6 1237.8 1368.4
1500-2000	1326.5 1382.8 1645.5	1636.6	1639.9	1644.0	1636.0
2000-2500	-	-	-	-	2126.6
2500-3000	2977.1	-	-	2839.9	-
3000-3500	3353.1	3319.7	3281.6	3352.3	3338.8

4. Acknowledgement
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