BEST: International Journal of Humanities, Arts, Medicine and Sciences (BEST: IJHAMS)
ISSN (P): 2348-0521, ISSN (E): 2454-4728
Vol. 5, Issue 12, Dec 2017, 109-116

OPTIMIZATION OF VARIOUS EXTRACTION METHODS, FOR QUERCETIN FROM ONION SKIN

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ABSTRACT

Onion (*allium cepa* L.) is the second most important horticultural crop worldwide, with an annual production of 66 million tons (FAO statistics, 2010). Large amounts of onion waste are produced both domestically and industrially, making it necessary to search for their utilization. These wastes get decayed and add themselves to soil causing odour and in some cases, causing harm to the environment. Hence, there is a need to find other uses of onion waste. The objective of the present work is to explore the possibility of utilizing onion wastes, for their nutraceutical values as food ingredients, which would greatly add to the value of waste. Attempts were made to extract Quercetin, a potent antioxidant, through step wise, continuous and vacuum assisted solvent extraction procedures. Quantification of Quercetin was done through Spectro photometric analysis and HPLC. An attempt to develop micro emulsions was carried out but, there is scope for further studies in this area.

KEYWORDS: Onion & Quercetin

INTRODUCTION

ONION

(KRYSTYNA P, 2007) Onions (Allium cepa L) are regarded as the most important crops worldwide and are consumed as young green plants or bulbs. They are valued for their distinctive pungency and flavor that improves the taste of other foods. Onions are considered as the second most horticultural crop, with annual production of around 66 million tones. Onions can be processed into the following products:

- Dehydrated onion
- Dehydrated onion powder
- Dehydrated onion granules
- Dehydrated onion flakes
- Dried onion-minced or diced
- Frozen onion rings
- Preserved onion in vinegar

ONION WASTE MANAGEMENT AND UTILIZATION

Industries come up with a way to convert the waste to useful products. This reduces the environmental impact of onion waste disposal by converting waste streams into useful products resulting in low-waste food production. Jaime *et al* (2001) reported that, the onion tissues richest in fructans were the fleshy layers, so the outer two fleshly layers turned out to be the best onion by-products, as a possible fructan source.

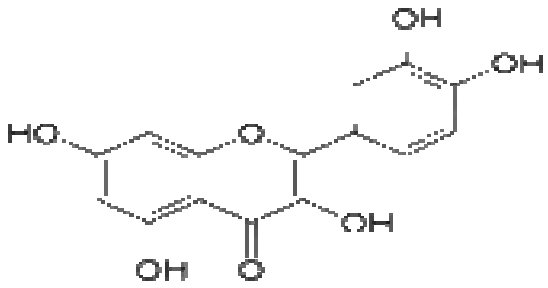
Onions waste can be processed by grinding and pressing to obtain several onion by-products, such as onion juices and bagasse. In order to obtain safe onion products, these onion by-products can be stabilized by different preservation technologies such as freezing, pasteurization or sterilization. Moreover, new vinegar production and fertilizer (compost) from worthless onions has been investigated.

QUERCETIN

- **FORMULA: C_{15} H_{10} O_7**
- **MOLAR MASS: 302.236 g/mol**
- **DENSITY: 1.80 g/cm3**

(PARUL *et al,* 2007) Quercetin, a bio active flavonoid found in fruits and vegetables, has proven beneficial impact on human health. It is one of the most potent antioxidants, preventing cardiovascular and neurodegenerative diseases. Quercetin has the highest concentration in the skins of most onions, where it impacts the yellow brown colour. The onion flesh contains a wide range of quercetin.

STRUCTURE



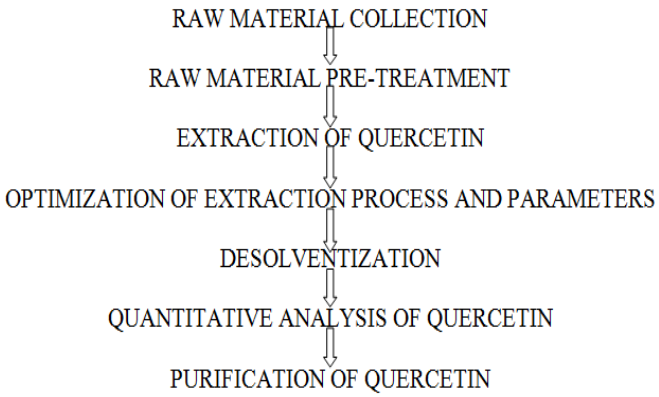
(MALGORZATA, 2008) A molecule of Quercetin contains five hydroxyl groups, whose presence determines the compounds biological activity and the possible number of derivatives. The main groups of Quercetin derivatives are glycosides and ethers.

HEALTH BENEFITS OF QUERCETIN: (PARKINSON'S AND ALZHEIMER'S, 2007)

- Antioxidant property
- Allergy, Asthma, Atopic disease
- Anti-Cancer Activity
- Reduction in development of Cardiovascular diseases.

METHODOLOGY

[DMITTRIENKO *et al,*2012 *;* SANGHAVI *et al,* 2014 ; GULATI *et al,* 2012 ; PANKAJ *et al,* 2012]



RESULTS AND DISCUSSIONS

Raw Material Collection

Fresh onion peels were collected from Karunya University Hostel mess, and is pre-treated in Food Processing engineering department R&D laboratory.

RAW MATERIAL PRE-TREATMENT

- Onion peels were washed thoroughly and dried in the Cross flow drier at 60ºC for a period of 2-3 hours.
- This temperature is maintained so as to maintain the pigment stability.
- The dried peels were taken and ground to make a fine powder and used as a starting material for the extraction process.
- The size reduction is done in comminuting mill with a mesh size of 5mm.

OPTIMIZATION OF EXTRACTION PROCESS AND PARAMETERS

Sl. No	Parameters	Optimized Condition
1	TIME	150 MINUTES
2	TEMPERATURE	80°C
3	PH	2

36 º brix is maintained, for the concentrated sample.

EXTRACTION OF QUERCETIN: [Dmitrienko et al., 2012]

The extraction procedure carried out was a modified protocol of Dmitrienko *et al*, 2012. Extraction procedures were optimized and the new extraction procedure involved pure ethanol extraction, followed by an acid treatment (citric acid) and then successive De-solventization.

Extraction	Type of Extraction	Yield
50 g onion peel powder extracted with 350 volumes of ethanol at 80°C for 16 cycles. The extract is then treated with 12 volume of citric acid for 20 minutes at 80ºC followed by De-solventization	Vaccum-assisted Soxhlet extraction	12-15 % of Yield

Amount of onion peel powder used for extraction = 50 g

Amount of crude extract obtained = 30 ml

Concentration of Quercetin in the Extract

= Abs. at 540 nm× Molecular weight of Quercetin× Dilution factor×1000

Molar extinction co-efficient × Cuvette Length (1 cm)

DESOLVENTIZATION

De-solventization was carried out using Rotary evaporator in the Analysis lab, with operating conditions of pressure 175 mbar vaccum pressures, 100 rpm at60°C. The samples were concentrated under reduced pressure conditions.

QUANTITATIVE ANALYSIS OF QUERCETIN

UV SPECTROPHOTOMETER: [Sanghavi *et al.*, 2014]

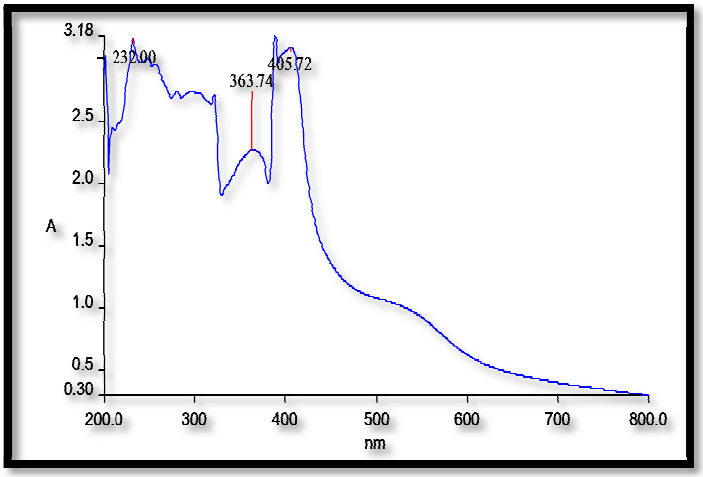
Scan Range: 200-800 nm

Interval: 1 nm

Absorbance: 0.90

nm: 540 nm

Dilution factor: 3



Graphical Representation of Quercetin Concentration

1% solution of crude extract was prepared with 95% ethanol and absorbance at 540 nm. Dilutions were done to get the absorbance values within the range of 1. Quantification of Quercetin was estimated using molar extraction coefficient.

Quercetin Concentration

$$= \frac{\text{Abs. at 540 nm} \times \text{Molecular weight of Quercetin} \times \text{Dilution factor} \times 1000}{\text{Molar extinction co-efficient} \times \text{Cuvette Length (1 cm)}}$$

PURIFICATION

The two procedures involved in the purification of Quercetin are :

- Aqueous Two Phase Method
- Liquid – Liquid Extraction Method

AQUEOUS TWO PHASE METHOD

In this method trials were conducted with 5g Polyethylene glycol [PEG] – 1500, 4000, 8000 and 2g salts of each Ammonium Sulphate and Magnesium Sulphate.

Layers were not foremed/seperated properly.

LIQUID LIQUID EXTRACTION METHOD

In this method the reagents used were chloroform, acetone, methano and petroleum ether

PROCEDURE

5ml crude extract + 100ml distelled water + 70ml reagents in seperating funnel

This is kept for few minutes until a clear separated layer of purified quercetin is formed

Discharge the solvent and purified Quercetin separately.

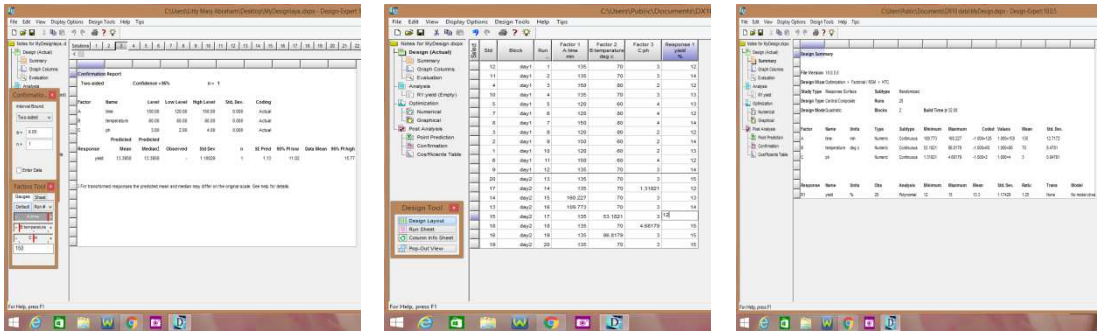
Chloroform is the best reagent that can be used for the purification and isolation of pure Quercetin.

OPTIMIZED RESULTS

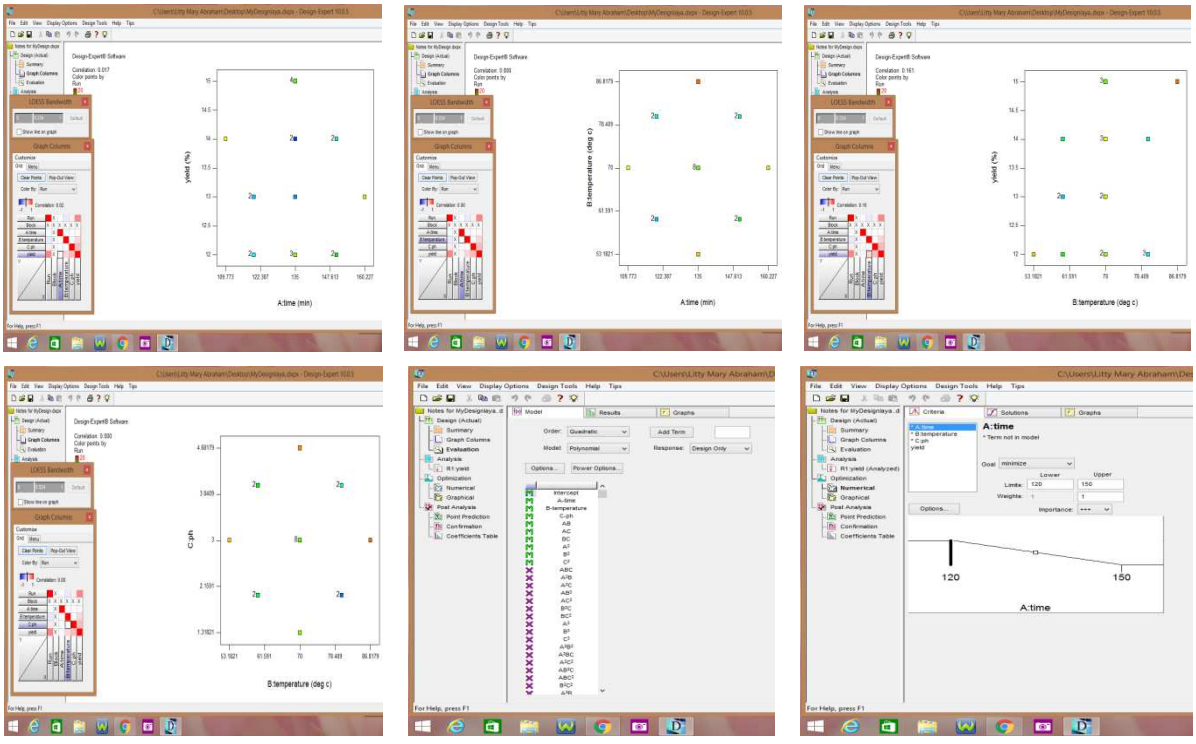
- Optimization : Yield
- Objective : To obtain a good yield of Quercetin
- Parameters : time
  : temperature
  : ph
- Methodology: Response surface methodology
- Determined : Central composite design(CCD)

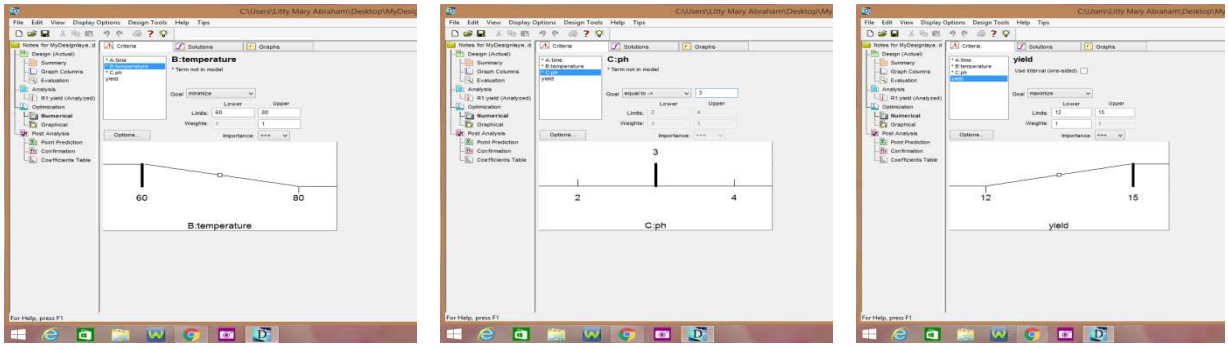
METHODOLOGY

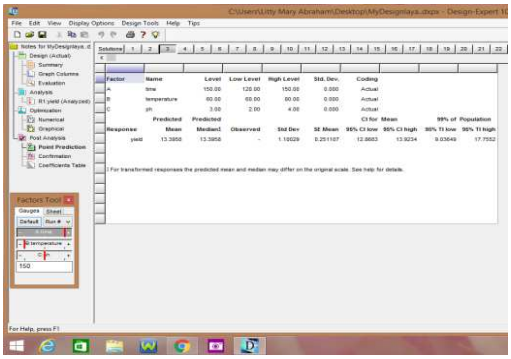
Fixing Parameter



- Fixing response:- yield
- By applying factors, its range & response in “Design-expert 10” software, following result will be obtained.







RESULTS

Optimization of Extraction Process and Parameters by Non Linear Regression Method

SL NO	Parametes	Optimized Result
1	TIME	150 MIN
2	TEMPERATURE	80 DEGREE
3	PH	2

36 º brix is maintained for the concentrated sample

MODELLING EQUATION

y = -1065.55550-63.5398*A4.85728*B+11.38532*C+41.24855*+0.29348*A*B1.44565*A*C+2.32506*A-0.012287 * B * C + 0.071739 * B - 0.14565 *C-18.52083 * A^2 + 0.015911 *B^2-0.068210*C^2-0.35583

Where, Y- Yield

A- Temperature

B- Time

C- Ph

OPTIMIZATION OF EXTRACTION PROCESS AND PARAMETERS BY CENTRAL COMPOSITE DESIGN

- Time = 150 min
- Temperature = 60̊ C
- Ph = 3

RESPONSE

Yield = 13%

SUMMERY AND CONCLUSIONS

Onion (*allium cepa* L.) is the second most important horticultural crop worldwide with an annual production of 66 million tons (FAO statistics, 2010). Large amounts of onion waste are produced both domestically and industrially, making it necessary to search for their utilization. These wastes get decayed and add themselves to soil causing odour and in some cases, causing harm to the environment. Hence, there is a need to find other uses of onion waste. The objective of the present work is to explore the possibility of utilizing onion wastes, for their nutraceutical values as food ingredients, which would greatly add to the value of waste. Attempts were made to extract Quercetin, a potent antioxidant, through step wise,

continuous and vacuum assisted solvent extraction procedures. Quantification of Quercetin was done through Spectro photometric analysis and HPLC. An attempt to develop micro emulsions was carried out but, there is scope for further studies in this area.

Efforts were made in the present study to bring about effective Onion waste management. Towards this objective, studies were done to optimize an extraction procedure for effective extraction of Quercetin from Onion peel.

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