Journal of Science and Technology
ISSN: 2456-5660 Volume 7, Issue 02 (MAR-APR 2022)

www.jst.org.in *DOI: https://doi.org/10.46243/jst.2022.v7.i02.pp315-321*

DEVELOPMENT OF A MACHINE AND DETECTION OF GLYCOALKALOIDS IN POTATO USING IMAGE PROCESSING TECHNIQUE

A. Caroline [1], Abitha Francis[2(*)], Bhuvaneshwari [2], Madhumitha.R[2], Poojaa K[2]

[1]Assistant Professor, Department of Food Processing and Preservation Technology, School of Engineering, Avinashilingham Institute for Home Science and Higher Education for Women, Tamil Nadu, India

[2]Undergraduate students, Department of Food Processing and Preservation Technology, School of Engineering, Avinashilingham Institute for Home Science and Higher Education for Women, Tamil Nadu, India

Email: abithafrancis2001@gmail.com

To Cite this Article
A. Caroline, Abitha Francis, Bhuvaneshwari, Madhumitha.R, Poojaa K*"***DEVELOPMENT OF A MACHINE AND DETECTION OF GLYCOALKALOIDS IN POTATO USING IMAGE PROCESSING TECHNIQUE***"*, *Journal of Science and Technology*, *Vol. 07, Issue 02, Mar-April 2022.*

Article Info
Received: 26-04-2022 *Revised: 18-04-2022* *Accepted: 26-04-2022* *Published: 30-04-2022*

DEPARTMENT OF FOOD PROCESSING AND PRESERVATION TECHNOLOGY- SCHOOL OF ENGINEERING-AVINASHILINGAM INSTITUE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN- AYYA AVINASHILINGAM VARAPALAYAM - THADAGAM POST – COIMBATORE – 641108 – TAMIL NADU-INDIA.

Abstract: Glycoalkaloids are secondary natural poisonous metabolites produced by plants of the Solanaceae family. Glycoalkaloids from solanaceous plants vary depending on species. The two major glycoalkaloids found in potatoes are Solanine and chaconine. The average potato contains 0.075 mg of solanine and chaconine. The doses of 200–400 mg for adult humans and 20–40 mg for children can cause toxic symptoms to human health. Commercial potatoes have GA content of less than 0.2 mg. This research aimed at determining the total glycoalkaloid content present in potatoes using image processing technique. It is one of the non-destructive method and images can be stored and retrieved easily. Potatoes were collected from local markets in Coimbatore. The major components used in this machine are Raspberry Pi, web camera, Lcd module, memory card. The Raspberry pi is powered up with 5V power supply through USB cable. The Button interfaced with raspberry pi is triggered to capture the image from camera to classify the level of glycoalkaloids and display the result in LCD module. Through this glycoalkaloid detector the amount of glycoalkaloid present in the potatoes can be determined by both milligram and percentage values. It is a cost-effective method and ensures food safety.

www.jst.org.in *DOI: https://doi.org/10.46243/jst.2022.v7.i02.pp315-321*

Keywords: Potato, glycoalkaloids, solanine, chaconine, image processing, Raspberry pi.

I. Introduction

Glycoalkaloids (GAs) are nitrogen containing compounds generally found in some parts of plant species of Solanaceae family mainly in tomato, potato, thorn apple, capsicum, and eggplant. Presence of glycoalkaloids in plants is to prevent from microbial attack and also acts as second natural poisonous metabolites to human being. GAs acquires during postharvest, transportation, storage, and exposure to sunlight during marketing. Glycoalkaloids mainly in potatoes are alpha-solanine and alpha-chaconine have much toxicity than in tomato. Adverse effect of glycoalkaloid poisoning results in a variety of neurological effects such as drowsiness, shaking and disturbed vision. Other symptoms associated with glycoalkaloid poisoning from potatoes include nausea, vomiting, abdominal cramps, and diarrhoea.

This glycoalkaloid detector is aimed to identify the total glycoalkaloid content in both mg/kg as well as in percentage with the help of image processing technique. The USB camera in this device captures the image and start out mapping all over the greener surface to detect the total glycoalkaloid content.

Figure 1.1: potato

Figure1.2: sprouted potato

II.Materials and methods

The Raspberry Pi Compute Module 3+ (CM3+) is a range of DDR2-SODIMM-mechanically-compatible System on Modules (SoMs) containing processor, memory, eMMC Flash (on non-Lite variants) and supporting power

circuitry. I2C 16x2 Arduino LCD Screen is using an I2C communication interface. It means it only needs 4 pins for the LCD display, GND, SDA, SCL.

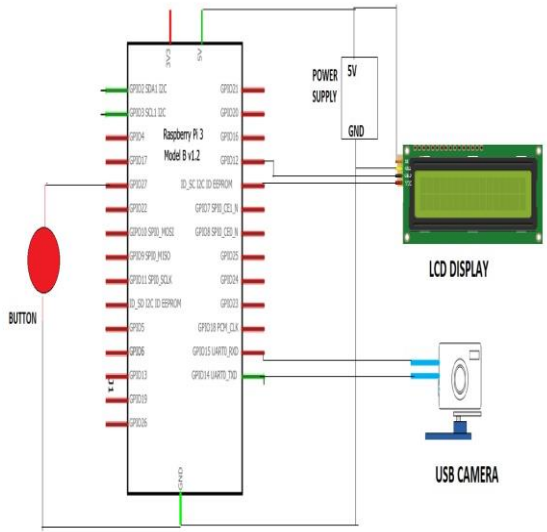


Figure1.3:Block diagram

Methodology

Camera is connected to the system. The monitor is connected to the Raspberry Pi through VGA to HDMI converter The first camera is projected on the potato then by pressing the keyboard keys to capturing the image of the potato. Then the captured image is processed using Neural Network to process the image to identify the disease. After capturing the image, pre-processing like removing the noise will be done, then it is processed through layers to identify the toxins.

Pre-processing:

Taking all these variations into consideration, we need to perform some pre-processing on any image data. RGB is the most popular encoding format, and most "natural images". Also, among the first step of data pre-processing is to make the images of the same size**.** In deep learning, a convolutional neural network (CNN) is a type of deep neural networks, which deals with the set of data to extract information about that data. Contours can be explained simply as a curve joining all the continuous points.

Figure1.4:Equipment-Glycoalkloid detector

III. Results and discussion

The pre-processing images are trained and model file is generated. The testing process is enabled after pressing the button and the camera captures the potato image and compares with model file to verify the placed object is Potato or not.

To classify the level of glycoalkaloids the Convolution neural network and open cv contours techniques is implemented.

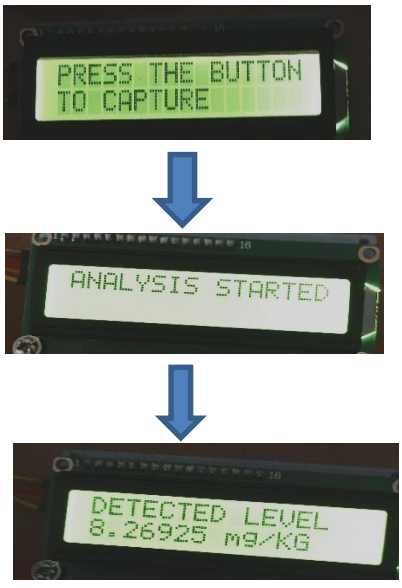


Figure1.5:Analysis of glycoalkloid in potato

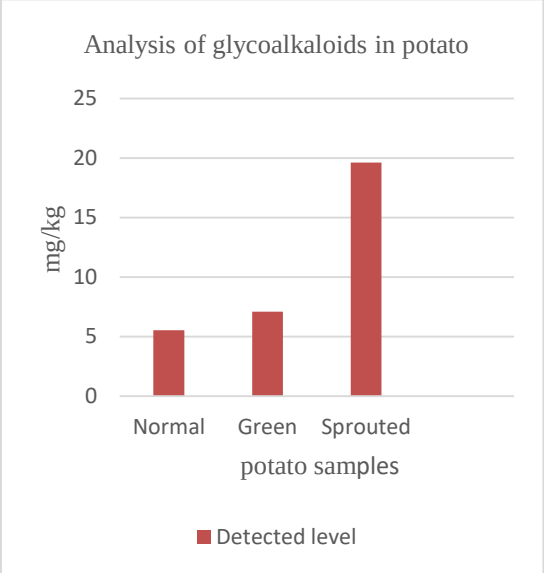
The data is being collected in the form of potato images that portrays the scanned parameters of potatoes with several conditions and the collected data are being trained with these conditions. A model file has been developed

for acquiring the previous data. Contour method is applied to find the level of glycoalkaloids in percentage and displayed the value in LCD.

Sample	mg/kg	Percentage
Normal	5.538	2.2152
Green	7.08325	2.83329
Sprouted	19.619	7.847899

Table1.1: Glycoalkaloid content in potatoes

Bar chart representation of analysis of glycoalkaloids in potato



Normal potato on average contains 12–20 mg /kg of glycoalkaloids, the normal potato that chosen for analysis weighs about 142g contains 5.538mg of glycoalkaloid content. 166g of green skinned potato contains 7.0832 mg, while a green potato contains average 250–280 mg/kg of glycoalkaloids and 320g of sprouted potato contains 19.6197mg, the average value of sprouted potato is 1500 –2200 mg/ kg. The toxic dose is approximated at 2-5 mg/ kg body weight while the lethal dose is estimated at 3-6 mg/kg of body weight. Sprouts contain higher levels than do leaves or tubers. It is known that light and heat or mechanical injury stimulates glycoalkaloid synthesis. Exposure to

light greatly increases the formation of chlorophyll and glycoalkaloids. The green colour of chlorophyll indicates that there is an excess of glycoalkaloids in potato.

The entire potato plant contains glycoalkaloids, but the highest concentration is found in the leaves, flowers, green skin, and sprouts. The lowest concentration is found in the white body of the potato. Toxicity is increased by physical injury to the plant, low storage temperature, and storage in bright light. Cooking potato by baking, boiling, frying, and microwaving does not eliminate glycoalkaloids. By removing the skin before cooking can reduce the glycoalkaloid content in the raw potatoes. By analysing the glycoalkaloid content in this device using three different potatoes (normal, green, and sprouted), sprouted potato contains the highest level than the other potatoes.

IV. Conclusion:

The glycoalkaloids can be easily occur in potato during harvest, transport or storage and it causes damage to the potato. Potato should be stored in 7`C, since higher temperature can also occur the growth of glycoalkaloid level. Sunlight gives fastest glycoalkaloid content in potato tubers. Glycoalkaloid content can be reduced by peeling and cutting and boiling in water. To detect the glycoalkaloid content present in potato image processing technique is developed. Through glycoalkaloid detector it can be able to analyse the glycoalkaloid level present in potato. To avoid the consumption of natural toxins in potato, glycoalkaloid detector can be easily detected and ensures food safety.

References

1.Acharya, Tinku, and Ajoy K. Ray. Image processing: principles and applications.2019, John Wiley & Sons
2.Ahmed, Mukhtar, Zartash Fatima, Pakeeza Iqbal "Potato Modeling." In Systems Modeling, pp. 383-401. Springer, Singapore, 2020.
3.Al-Mallahi A, Kataoka T, Okamoto H, Shibata, Y. An image processing algorithm for detecting in-line potato tubers without singulation. Computers and Electronics in Agriculture 2019:70: 239-244.
4.Bejarano, Liliana, Eric Mignolet, André Devaux, Nelly Espinola, and Yvan Larondelle "Glycoalkaloids in potato tubers: the effect of variety and drought stress on the α-solanine and α-chaconine contents of potatoes." Journal of the Science of Food and Agriculture 80, no. 14 (2020): 2096-2100.
5.Benkeblia, Noureddine. "Potato Glycoalkaloids: occurrence, biological activities and extraction for biovalorisationreview." International Journal of Food Science & Technology 55, no. 6 (2020): 2305-2313.
6.Deepthi inoka uluwaduage, s lecturer, s Lanka "Glycoalkaloids, bitter tasting toxicants in potatoes" international journal of food science and Nutrition 3(4),188-193,2018.
7.Dougherty, Edward R. image processing methods. CRC Press, 2020.
8.Du Cheng – Jin, Sun Da-Wen. Recent developments in the applications of image processing techniques for food quality evaluation. Trends in Food Science & Technology, 2019: 15:230-249.

9.EFSA Panel on Contaminants in the Food Chain (CONTAM), Dieter Schrenk, Margherita Bignami, Laurent Bodin, James Kevin Chipman, Jesús del Mazo, Christer Hogstrand et al. "Risk assessment of glycoalkaloids in feed and food, in particular in potatoes and potato-derived products." EFSA Journal 18, no. 8 (2020): e06222.

10.Ijemaru, Gerald K.,Augustine O.Nwajana, Emmanuel U. Oleka"Image processing system using MATLAB-based analytics." Bulletin of Electrical Engineering and Informatics 10, no. 5 (2021): 2566-2577.

11. K Przybyl, A Ryniecki, G Niedbala, W Mueller, P Boniecki, ,M Zarborowicz, K Koszela, S kujawa, RJ Kozlowski " Software supporting definition and extraction of the quality parameters of potatoes by using image analysis" Eighth international conference on digital image processing (ICDIP 2016) 10033,100332L, 2016.

12. Krzysztof Pyrybyl, Piotr Bonieeki, Krzysztof Koszela, Lukasz Gierz, Mateusz Lukomski " Computer vision and artificial neural network techniques for classification of damage in potato during storage process" Czech Journal of food science 37(2),135-140, 2019.

13.Machado, Rita MD, Maria Cecília F. Toledo, and Lucila C. Garcia. "Effect of light and temperature on the formation of glycoalkaloids in potato tubers." Food Control 18, no. 5 (2019): 503-508.

14. Maryam Tavakoli, Mohson Najafzadeh "Application of the image processing technique for separating sprouted potatoes in the sorting line" Journal of application Environmental and Biological science 4(11S) 223-227,2015.

15.Mendal Freidman, Carol E Levin "Glycoalkaloids and calystegine alkaloids in potato" Advances in potato chemistry and technology 167-194,2016.

16.Narasimharao kondamudi, Jacob K Smith, Owen M MC Dougal "Determination of Glycoalkaloids in potatoes and potato products by microwave assisted" American Journal of potato research 94(2), 153-159,2017

17.Nielsen, Søren D., Jesper M. Schmidt, Gitte H. Kristiansen, Trine K. Dalsgaard, and Lotte B. Larsen "Liquid chromatography mass spectrometry quantification of α-solanine, α-chaconine, and solanidine in potato protein isolates." Foods 9, no. 4 (2020): 416.

18.Oliva, Diego, Mohamed Abd Elaziz, and Salvador Hinojosa. "Image Processing." In Metaheuristic Algorithms for Image Segmentation: Theory and Applications, 2019, pp. 27-45. Springer, Cham.

19.Percival, G. C., and G. R. Dixon. "Glycoalkaloids." In Handbook of plant and fungal toxicants, pp. 19-35. CRC Press, 2020.

20.Przybylak, Andrzej, RadosławKozłowski, Ewa Osuch, Andrzej Osuch "Quality evaluation of potato tubers using neural image analysismethod." Agriculture 10, no. 4 (2020): 112.

21. P Singh, P Talukdar "Determination of shrinkage characteristics of cylindrical potato during convective drying using novel image processing technique" Heat and mass transfer 56(4),1223-1235,2020.

22. Reinis zarins, Zanda karuma "Glycoakaloids in potatoes" Department of food technology, Lativa University of agriculture 2017.

23.Sanjeev, Kumar, Narendra Kumar Gupta, Rajendra Kumar Isaac, and Suneeta Paswan. A review on potato disease detection using image processing." Progressive Agriculture 21, no. 1 (2021): 23-30.

24.Siddique, Md Abu Bakar, and Nigel Brunton. "Food Glycoalkaloids: distribution, structure, cytotoxicity, extraction, and biological activity." Alkaloids-their importance in nature and human life (2019): 13-5.

25. Sinead Eileen Milner, Nilgal Patrick Brunton Peter Wvn Jones, Nora Mary O' Berin. Stuart "Bioactivities of Glycoalkaloids and their aklycones from solanum species" Journal of agricultural and food chemistry 59(8), 3454-3484,2011

26.Singh, Brajesh, Som Dutt, and Pinky Raigond. "Potato Glycoalkaloids." In Potato, pp. 191-211. Springer, Singapore, 2020.

27.Tilahun, Shimeles, Hee Sung An, In Geun Hwang, Jong Hang Choi, Min Woo Baek, Han Ryul Choi, Do Su Park, and Cheon Soon Jeong. "Prediction of α-Solanine and α-Chaconine in Potato Tubers from Hunter Color Values and VIS/NIR Spectra." Journal of Food Quality 2020 (2020).

28.Tingey, Ward M. "Glycoalkaloids as pest resistance factors." American Potato Journal 61, no. 3 (2019): 157-167.

29. Young-Joo Lee, Beom- Soo Shin "Development of potato yeild monitoring system using machine vision" Journal of Biosystems Engineering 45 (4), 282-290, 2020. 30.Wan, Libin, Haidong Gao, Huoliang Gao, Rui Du, Fayun Wang, Yong Wang, and Mantang Chen "Selective extraction and determination of steroidal glycoalkaloids in potato tissues by electromembrane extraction combined with LC-MS/MS." Food Chemistry 367 (2021): 130724