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Novel Approach To Decrease Calcium Oxalate In Taro (Colocasia Esculental.) Flour Processing As Intermediary Product

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Abstract
A lab experiment was carried out during 2023-24 at the School of Agriculture Science, Research laboratory of Dr. C.V. Raman University, Khandwa, Madhya Pradesh. The invent of the study was on flour making process of taro roots and systematic process of quantitative estimation of calcium oxalates by titration method from taro flour and reduce level of calcium oxalates content among treatments of Taro flour.The result of the investigation shows that the significant effect on reduction of calcium oxalate in the treatment combination of just harvested+ 90 minutes soaking in 5 % $CaCl_2$+Oven dried (T_9) as compared to control (Untreated) (T_{10}). Reduced 63% calcium oxalate by T_9 combination as compared to T_{10}.

Keywords: *Taro (Colocasiaesculenta), Calcium Oxalate, Taro flour, $KMnO_4$ Titration*

INTRODUCTION

Arbi is a vegetable. Arbi is called Taro Root or Colocasia in English. Colocasiaesculenta(L.) Schott commonly known as taro is an emergent, semi-perennial, aquatic, and semi-aquatic stem-less herbaceous plant cultivated for its starchy corms. It belongs to the Araceae family of which about 140 genera and about 3750 extensively distributed species are known (Christenhusz and Byng, 2016). The species is allogamous and polymorphic (Rashmi et al., 2018). The corm is a reliable source of starch (70–80 g/100 g dry weight), fiber (0.80%), ash (1.2%), and fat (0.20%) but low in protein (1.5%) similar to many other tuber crops (Rashmi et al., 2018). The leaves are rich in nutritional and phytochemical compounds, however, they are greatly underutilized. They're also an essential source of thiamine, riboflavin, iron, phosphorus, and zinc and an exceptionally good source of vitamin B6, vitamin C, niacin, potassium, copper, and manganese (Magbalot-Fernandez and Umar, 2018).

Taro (ColocasiaesculentumL.) corm is one of the most nutritious and easily digested foods, but unfortunately contains anti-nutritional factors such as oxalates and phytic acid. The oxalateswhichcanleadtorisksofkidney stones, whilephyticacidreducesbioavailabilityofminerals.Therefor, theanti-nutritionalfactorsmutsberemoved or decreasedbeforeutilizationofcormasfoodbycarryingoutchemicalorphysicalprocesssuchassoaking,boiling, fermentationorcooking. So,theincorporationofchemicalandphysicalmethodsisexpectedtobeaveryefficientways ofprocessing.

To reduce the anti-nutritional factors of taro corm chips such as soluble oxalate and phytic acid, it should be soaked in calcium salts solutions. The soaking in calcium chloride solution (5%) for 60 minutes had the greatest effect. So, this treatment is very important for decreasing expected kidney stones risks, also improving bioavailability of minerals in case of using taro chips as replacer for potato chips or for preparing Taro flour foods.

The history of the origin of arbi dates back thousands of years. It is believed that it was first grown in Southeast Asia and New Guinea about 9000 years ago. After that its cultivation started in Formosa (ancient republic under

China), Philippines, Assam (India) and Timor Island. Later its cultivation reached Tonga, Samoa, New Zealand, Easter Island and Hawaii. Information shows that during the colonial period, arbi was repeatedly transported from West Africa to America, which was used for provisions of 18th century slave plantations. It has also been grown as a staple crop in China and Japan for thousands of years.

The presence of oxalates in food is considered harmful to health because of the negative effects it has on the consumer intake. Soluble oxalates bind with minerals such as K+, and Na+ rendering them unabsorbed through the intestinal wall into the bloodstream. Hence excessive intake of soluble oxalates can lead to the formation of kidney stones (Mitharwal et al., 2022, Savage and Dubois, 2006). Taro contains high carbohydrates (21.2%) and protein (6.6%) and low fat (0.67%). taro cannot be consumed directly because it contains calcium oxalate (CaC_2O_4). The calcium oxalate content in taro is 187.6 - 1,096.2 mg/100 g. The safe limit to the consumption of calcium oxalate for adults was 0.60-1.25 g per day for 6 consecutive weeks. Oxalate is a natural compound found in a variety of plant foods. There are two forms of oxalate in plants which are soluble and insoluble. In soluble form, oxalate is often found as a sodium salt. Soluble oxalate can be absorbed directly from food.

BACKGROUND OF THE INVENTION

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OBJECTIVE OF THE INVENTION

1.To invent the procedure of flour making from taro roots.
2.To invent systematic process of quantitativeestimation of calcium oxalate by titration method in taro flour.
3.To invent reduce level of calcium oxalate content among various treatment combinations oftaro flour.

LITERATURE REVIEW

Taro (Colocasiaesculenta L.), a tropical root crop, is widely consumed in Asia, Africa, and the Pacific Islands due to its rich carbohydrate content and nutritional benefits. However, its utilization in food products is constrained by the high content of calcium oxalate crystals, which are known to cause irritation in the mouth and contribute to kidney stone formation upon consumption (Subashini&Sathishkumar, 2012). Therefore, significant research has been conducted to identify innovative and effective methods to reduce calcium oxalate levels during taro processing.

Several studies have highlighted traditional methods like boiling, soaking, and fermentation to reduce oxalate levels. Subashini and Sathishkumar (2012) reported that boiling taro leaves and corms significantly reduced the total oxalate content, particularly the soluble fraction. However, such methods often result in loss of nutrients and degrade the sensory and textural properties of taro flour.

A more biochemical approach is the use of oxalate-degrading enzymes. Jacob et al. (2020) introduced a novel enzymatic treatment using oxalate oxidase, which yielded an oxalate-free starch with minimal impact on starch structure. Their optimized enzymatic process achieved up to 98.3% reduction in oxalate, showing significant promise for commercial-scale taro flour production.

Alkaline and acid soaking methods have also been explored. Kumoro et al. (2014) demonstrated that treating taro corm chips with baking soda ($NaHCO_3$) solution under optimized kinetic parameters could reduce calcium oxalate levels effectively. This method was found to be more environmentally friendly and less time-consuming compared to prolonged boiling or fermentation.

Other physical and chemical pretreatments, such as the combination of hot water blanching and activated charcoal, have also shown efficacy. Noviasari et al. (2021) revealed that physical methods, when integrated with sorbents like charcoal, can enhance oxalate reduction while retaining desirable flour properties. Similarly, Rozali et al. (2021) compared multiple immersion techniques—NaCl, lime, and tamarind solutions—and found that lime treatment reduced oxalate content most significantly, suggesting the utility of simple, locally available treatments in community processing systems.

Recent studies have also investigated fermentation as a biological approach to oxalate reduction. Sulaiman et al. (2020) identified microbial strains capable of metabolizing oxalate, and the fermentation duration and microbial composition were found critical in enhancing oxalate breakdown without compromising flour quality.

On a broader scale, Huynh et al. (2022) provided a comprehensive review of oxalate reduction in plant-based foods and emphasized that combinations of thermal, enzymatic, and biological techniques yield the most effective results. Integrating these strategies in taro processing could result in a safer and more functional intermediary flour product.

In summary, recent literature suggests that novel oxalate reduction techniques, such as enzymatic treatment, controlled fermentation, and combined physical-chemical approaches, offer practical and scalable solutions. These methods provide an effective balance between nutritional safety and functional integrity of taro flour, thereby enabling its wider use in health-conscious and nutritionally optimized food products.

MATERIAL AND METHODS

1. First aspectinventsquantitative estimation of calcium oxalates by titration method from taro roots
2. Second aspect quantitativeestimation process comprises of
i. Digestion of Taro flour
ii. Calcium oxalates and ferrous ions precipitation
iii. $KMnO_4$ Titration
3. Third aspect invent reduce level of calcium oxalates content among various treatments of Taro flour.
4. Fourth aspect preparation of Taro flour of different soaking time of 5% $CaCl_2$ and different drying methods (Sun, Solar and oven dried).
5. Five aspect various combinations

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60 Minutes soaking in 5 % $CaCl_2$ +Sun dried
75 Minutes soaking in 5 % $CaCl_2$ +Sundried
90 Minutes soaking in 5 % $CaCl_2$ +Sun dried
60 Minutes soaking in 5 % $CaCl_2$ +Solar dried
75 Minutes soaking in 5 % $CaCl_2$ +Solar dried
90 Minutes soaking in 5 % $CacC_2$ +Solar dried
60 Minutes soaking in 5 % $CaCl_2$ +Oven dried
75 Minutes soaking in 5 % $CaCl_2$ +Oven dried
90 Minutes soaking in 5 % $CaCl_2$ +Oven dried

CONTROL (UNTREATED)

Table 1. Effect on reduction level of calcium oxalate content in taro flour among the different combination of soaking duration and drying methods

	Treatment	Mean
T_1	60 Minutes soaking in 5 % $CaCl_2$ +Sun dried	66.00
T_2	75 Minutes soaking in 5 % $CaCl_2$ +Sundried	58.50
T_3	90 Minutes soaking in 5 % $CaCl_2$ +Sun dried	45.00
T_4	60 Minutes soaking in 5 % $CaCl_2$ +Solar dried	64.50
T_5	75 Minutes soaking in 5 % $CaCl_2$ +Solar dried	57.00
T_6	90 Minutes soaking in 5 % CaCl2 +Solar dried	43.50
T7	60 Minutes soaking in 5 % CaCl2 +Oven dried	60.00
T_8	75 Minutes soaking in 5 % $CaCl_2$ +Oven dried	49.50
T_9	90 Minutes soaking in 5 % $CaCl_2$ +Oven dried	34.33
T_{10}	Control (Untreated)	94.50
CD		**9.13**
SE(m)		**3.04**
CV		**9.22**

DESCRIPTION OF THE INVENTION:

Taro flour making process:

Selectionoftubers (just harvested tubers)

↓
2 times washing for removal of soil partials
↓
Peeling (Removal of outer layer or skin)
↓
Cutting(largecubes)
↓
Soaking (5%Calcium Chloride fordifferent duration such as 60, 75 and 90 minutes)
↓
Washing(2times)
↓
Cutting (Smallcubesin2mm)
↓
Blanching of taro(Boiling of taro cubes in water bath at 70 ^{0}C for 10 minutes)
↓
Drying of taro cubes(Sun, Solar and oven dryer methods)
↓
Milling (Grinding by mixer)
↓
Sieving of flour (by 0.25 mm Sieve)
↓
Flour

Sieving of taro flour method

Prepared taro flour method

Calcium Oxalate Content Analysis

TITRATION METHOD

The Calcium oxalate content was determined using the procedure involves three steps: digestion, Calcium oxalate precipitation and permanganate titration.

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Digestion: At this step, 1 g of flour was suspended in 95 mL of distilled water contained in a 125-mLvolumetric flask; 5 mL of 6N HCl was added and the suspension digested at 100 °C for 90 Minutes, followed bycooling, and then made up to 125 mL before filtration.

Calcium Oxalate precipitation: 62.5 mL of the filtrate were measured into a conical flask and two drops of methyl red indicator were added, followed by the addition of concentrated NH_4OH solution (drop wise) until the testsolution changed from its salmon pink color to a faint yellow color (pH 4-4.5). The content was then heated to100°C for 60 min, cooled for 35 minutes and filtered to remove precipitate containing ferrous ion. The filtrate was again heated to85- 90°Cfor 30 minutes and 5 mL of 5% $CaCl_2$solution was added while being stirred constantly for 10 minutes. After heating, it was cooled and left overnight at 10°C. The solution was then centrifuged at a speed of 2000- 2500 rpm for 20-25 min.The supernatant was decanted and the precipitate completely dissolved in 10 mL of 10% (v/v) H_2SO_4solution.

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Permanganate Titration: Titrated against 0.1N standardized $KMnO_4$, the solution from color less to faint pink color which is persisted for 30 seconds. The Calcium Oxalate content was calculated using the formula.

$$\text{Calcium Oxalate content} = \frac{\text{T} \times \text{Vme} \times \text{DF}}{\text{ME} \times \text{MF}} \times 10^5$$

Where: T = Titer value of $KMnO_4$ (mL),
V_{me}= Volume—Mass equivalent (that is 1mL of 0.1N $KMnO_4$, = 0.00225 g of anhydrous Oxalic Acid),
Df = Dilute factor (Vt/A that is, total volume of titrate/Aliquot used = 2),
Mf = Mass of sample used,
ME = Molar equivalence of $KMnO_4$ in Oxalate concentration in g/dm^3 = 5.

RESULT AND DISCUSSION

The results of the study revealed that different treatments significantly affected the calcium oxalate content in taro flour. The treatment T9 (90 minutes soaking in 5% $CaCl_2$ + oven dried) showed the lowest calcium oxalate concentration of 34.33 mg/100g, while the untreated control (T10) had the highest concentration of 94.50 mg/100g. This indicates a 63.67% reduction in calcium oxalate due to the T9 treatment.

The descending order of oxalate content across treatments was:
T10 > T1 > T4 > T7 > T2 > T5 > T8 > T3 > T6 > T9

Among all treatment combinations, increasing the soaking time in $CaCl_2$ solution consistently contributed to a reduction in calcium oxalate levels, with the most pronounced effects seen when combined with oven drying. Treatments involving solar and sun drying also reduced oxalate levels, but not as effectively as oven drying. This suggests that prolonged soaking in calcium-rich solutions, followed by controlled drying conditions, enhances the removal or precipitation of soluble oxalates in taro flour.

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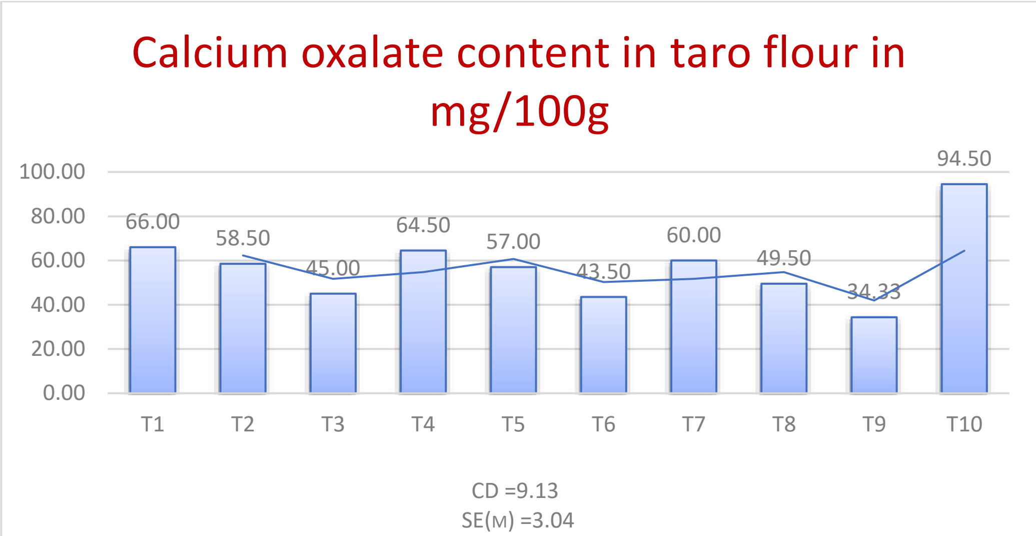

Figure: 1

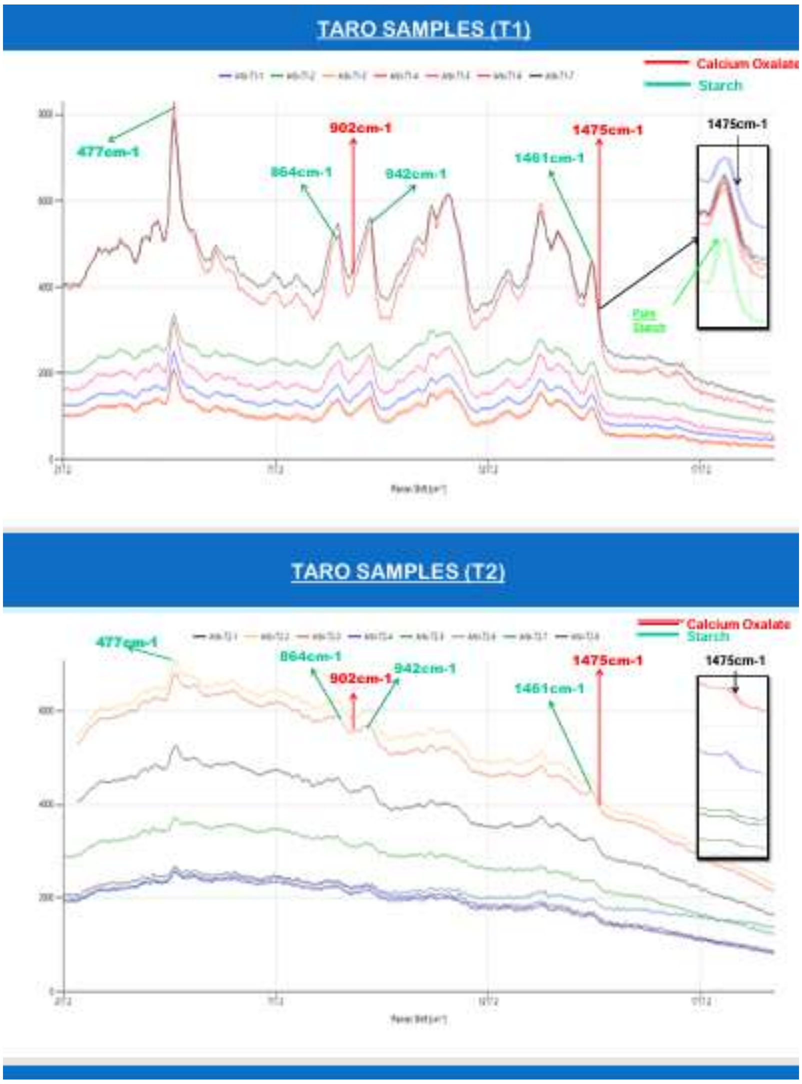

Figure: - 2

The study therefore confirms that T9 treatment is an effective method to reduce harmful oxalates, improving the nutritional safety of taro-based food products.

CONCLUSION

In the Raman spectroscopic analysis of the Taro sample, a small hump was observed at 1475cm^{-1}. This feature was not present in the spectrum of pure starch, suggesting that the hump is not characteristic of starch. Based on this observation, it can be inferred that oxalate may be present in the sample at low concentrations.

This study confirms that the method of soaking taro cubes in 5% calcium chloride solution followed by drying significantly reduces calcium oxalate content in taro flour. Among the treatment combinations, T9 (90 minutes soak + oven drying) was the most effective, achieving a 63.67% reduction compared to untreated control. This novel approach demonstrates a promising, low-cost and scalable solution for reducing anti-nutritional factors in taro flour. It has potential application in both household and commercial food processing settings. The method not only improves mineral bioavailability but also helps in reducing the risk of kidney stone formation associated with high oxalate intake.

Further research may explore the impact of these treatments on the nutritional composition, taste, and usability of the final flour product in food formulations.

REFERENCES

- Huynh, N. K., Nguyen, D. H. M., & Nguyen, H. V. H. (2022). Effects of processing on oxalate contents in plant foods: A review. Food Research International, 157, 111118. https://doi.org/10.1016/ j.foodres.2022.111118
- Jacob, M. P. K., Suvarnaa, S., Belura, P. D., Wongsagonsup, R., Agooc, E. M. G., &Janairo, J. I. B. (2020). Optimization of oxalate-free starch production from taro flour by oxalate oxidase assisted process. Preparative Biochemistry & Biotechnology, 51(2), 105–111. https://doi.org/10.1080/10826068.2020.1795672
- Kumoro, A. C., Putri, R. D. A., Budiyati, C. S., Retnowati, D. S., &Ratnawati. (2014). Kinetics of calcium oxalate reduction in taro (Colocasiaesculenta) corm chips during treatments using baking soda solution. Procedia Chemistry, 9, 102–112. https://doi.org/10.1016/j.proche.2014.05.013
- Noviasari, S., Lubis, Y. M., Rozali, Z. F., &Sulaiman, I. (2021). Combination of physical methods and active charcoal in reducing calcium oxalate levels in Kimpul taro flour (Xanthosomasagittifolium). Elkawnie: Journal of Islamic Science and Technology, 7(1), 1–10. https://doi.org/10.22373/ej.v7i1.17701
- Rozali, Z. F., Zulmalisa, Z., Sulaiman, I., Lubis, Y. M., &Noviasari, S. (2021). Decreased calcium oxalate levels in the purple taro flour (Colocasiaesculenta) from Aceh Province, Indonesia using three immersion methods. IOP Conference Series: Earth and Environmental Science, 711(1), 012022. https://doi.org/10.1088/1755-1315/711/1/012022
- Subashini, S., &Sathishkumar, K. (2012). Composition and availability of soluble and insoluble oxalates in raw and cooked taro (Colocasiaesculenta var. Schott) leaves. Journal of Food Composition and Analysis, 27(2), 123–127. https://doi.org/10.1016/j.jfca.2012.04.003
- Sulaiman, I., Noviasari, S., Lubis, Y. M., Rozali, Z. F., &Eriani, K. (2020). Analysis types and functions of microbes and duration of fermentation in the process of reducing levels of concentration oxalate levels in taro Kimpul. Systematic Reviews in Pharmacy, 11(11), 1450–1456. https://doi.org/10.31838/srp.2020.11.205
- Jacob Kizhakedathila, M. P., Suvarnaa, S., Belura, P. D., Wongsagonsup, R., Agooc, E. M. G., &Janairoc, J. I. B. (2020). Optimization of oxalate-free starch production from Taro flour by oxalate oxidase assisted process. Preparative Biochemistry & Biotechnology, 51(2), 105–111. https://doi.org/10.1080/ 10826068.2020.1795672(Taylor & Francis Online)
- Kumoro, A. C., Putri, R. D. A., Budiyati, C. S., Retnowati, D. S., &Ratnawati. (2014). Kinetics of Calcium Oxalate Reduction in Taro (ColocasiaEsculenta) Corm Chips during Treatments Using Baking Soda Solution. Procedia Chemistry, 9, 102–112. https://doi.org/10.1016/j.proche.2014.05.013(sci-hub.in)
- Oyim, I. R., Anyango, J. O., &Omwamba, M. N. (2022). Effect of Pre-Gelatinization Conditions on the Total Oxalate Content and Techno-Functional Properties of Taro (Colocasiaesculenta) Flour. Food and Nutrition Sciences, 13(6), 511–525. https://doi.org/10.4236/fns.2022.136039(OALib)
- Marzuki, S. U., Yolanda, K. D. P., Rezeki, S., &Khairi, S. (2023). Kinetikareduksikalsiumoksalatdanpengeringanumbitalas (Colocasiaesculenta L.) padaperlakuanperendamandenganlarutanNaCl. Agrointek: JurnalTeknologiIndustriPertanian, 17(1), 1–10. https://doi.org/10.21107/ agrointek.v17i1.20208(Trunojoyo Journal)
- Rozali, Z. F., Zulmalisa, Z., Sulaiman, I., Lubis, Y. M., &Noviasari, S. (2021). Decreased calcium oxalate levels in the purple taro flour (ColocasiaEsculenta) from Aceh Province, Indonesia using three immersion methods. IOP Conference Series: Earth and Environmental Science, 711(1), 012022. https://doi.org/10.1088/1755-1315/711/1/012022(openrecruitment.radenfatah.ac.id)

- Fufa, T. W., Oselebe, H. O., Abtew, W. G., &Amadi, C. O. (2023). Physicochemical Analysis of Taro (Colocasiaesculenta (L.) Schott) Accessions. Asian Journal of Research in Agriculture and Forestry, 9(4), 29–41. https://doi.org/10.9734/ajraf/2023/v9i4232(journalajraf.com)
- Hang, D. T. (2020). Oxalate content of taro (Colocasiaesculenta) tubers grown in central Vietnam. Livestock Research for Rural Development, 32(2). http://www.lrrd.org/lrrd32/2/hangd32029.html(lrrd.org)
- Sulaiman, I., Noviasari, S., Lubis, Y. M., Rozali, Z. F., &Eriani, K. (2020). Analysis types and functions of microbes and duration of fermentation in the process of reducing levels of concentration oxalate levels in taro Kimpul. Systematic Reviews in Pharmacy, 11(11), 1450–1456. https://doi.org/10.31838/srp.2020.11.205(openrecruitment.radenfatah.ac.id)
- Zulkhairi, A. M., Razali, M., Umikalsum, M. B., Norfaizal, G. M., Athirah, A. A., &Aisyah, M. N. S. (2020). Determination of Oxalates in Corms of Selected Taro (Colocasiaesculenta) Varieties in Malaysia Using Ultra High-Performance Liquid Chromatography. Asian Journal of Chemical Sciences, 7(3), 28–37. https://doi.org/10.9734/ajocs/2020/v7i319023(journalajocs.com)
- Noviasari, S., Lubis, Y. M., Rozali, Z. F., &Sulaiman, I. (2021). Combination of Physical Methods and Active Charcoal in Reducing Calcium Oxalate Levels in Kimpul Taro Flour (Xanthosomasagittifolium). Elkawnie: Journal of Islamic Science and Technology, 7(1), 1–10. https://doi.org/10.22373/ej.v7i1.17701(Jurnal Ar-Raniry)