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UTILIZATION OF FRYING WATER TO INCREASE PHENOLIC AND FLAVONOID CONTENT IN BRASSICA VEGETABLES AS ANTIOXIDANT AGENTS FOR THE BODY

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ABSTRACT

Background: Brassica vegetables are a type of vegetable that is easy to find and widely consumed by people in Indonesia because of their high variety and relatively cheap prices. Brassica vegetables such as cauliflower, broccoli, kale, and sprouts have a high antioxidant content due to their phenolic compounds. In general, Brassica vegetables are not consumed raw but through processing. The antioxidant compounds contained in brassica can be known depending on the processing method used. Various processing methods, one of which is the processing method using Air Frying. **Objective:** The purpose of this Systematic Review study was to examine the use of Air Frying in Brassica vegetables to increase the content of phenolic compounds and flavonoids. **Method:** The design used in this study is a systematic literature review (SLR) using the preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) method by searching journals in electronic databases published on Google Scholar, Pubmed, and Science Direct, which have been published since from 2013 to 2023. These articles were then extracted by paying attention to the titles and abstracts to see their suitability for the topics discussed. **Results:** The 5 selected articles show that hot air frying technology makes the nutritional quality of food higher than conventional frying, and becomes a practical alternative for getting healthier fried foods because of the possibility of reducing fat, lipid degradation, and oxidation. Air frying is becoming a more suitable processing method for processing brassica vegetables. Frying with high-temperature air for a short time will prevent the nutritional content of vegetables during processing. Air fryers are capable of significantly increasing the TFC and TPC of brassica vegetables regardless of the variety. **Conclusion:** The application of Air Frying improves the phenolic and flavonoid status and antioxidant potential of selected Brassica Vegetables.

Keywords: Brassica, air frying, antioxidants
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INTRODUCTION

Brassica vegetables are vegetables such as cauliflower, broccoli, kale, and sprouts which are very popular and are among the most consumed vegetables in the world. Brassica is known to have antioxidant activity and is known to be rich in phenolic compounds. Phenolics react and capture free radicals thereby inhibiting oxidative stress. Phenolics are also commonly known to exhibit anti-allergic, anti-inflammatory, antimicrobial, and anticancer activities (Agiriga and Siwela, 2018). Epidemiological studies have shown that this vegetable is associated with a reduced risk of several types of cancer, type 2 diabetes, and cardiovascular disease(Bhandari and Kwak, 2015). Consumption of Brassica vegetables being one of the most important contributing factors in cancer prevention can be attributed to the high levels of antioxidants found in these vegetables (Becker and Juvik, 2016). In addition, this vegetable also has a composition of glucosinolates containing sulfur, anthocyanins, terpenes, flavonoids, S-methyl cysteine sulfoxide, coumarins, and other minor compounds, which are useful plant metabolites. These compounds are a large group of antioxidant compounds that are present in appreciable amounts in these vegetables and are often considered to be the most abundant antioxidants in the human diet

(Nandasiri *et al.*, 2023). However, these bioactive compounds can easily be lost during the processing process, so proper management is necessary. Processing is a prerequisite for most foods to improve metabolism and digestion in the human digestive system. However, many changes in the physical characteristics of food, such as appearance, sensory properties, and chemical composition occur during processing (Solanum *et al.*, 2021).

Water frying is a conventional fryer that uses hot air and is combined with high-speed air circulation. An air fryer aims to increase the uniform contact between the food and the oil droplets in the hot air stream to reduce the total amount of oil required to achieve a more effective cooking process (Wang *et al.*, 2021). In air fryers, convective heat transfer occurs between the surface of the food and the hot air followed by conductive heat transfer within the food ingredients (Fikry *et al.*, 2022). The advantages of Air Frying can be a good processing alternative because the air frying process can reduce the amount of oil content and polar compounds. This tool is very suitable for people who are running a healthy diet. In addition, the use of Air Frying can also minimize the loss of nutritional value in food. The application of higher air-frying temperatures (>140oC) for shorter time intervals during the air-frying process and supported by consistent hot air circulation throughout the system makes it ideal for preserving nutrients and other ingredients. In addition to having advantages, Air frying also has disadvantages, namely, the price of the equipment is relatively expensive and requires a large amount of electricity. So Air Frying is still rarely used among the public (Zaghi *et al.*, 2019). Therefore it is necessary to carry out a literature review to prove that there is an increase in phenolic and flavonoid compounds in brassica vegetables by utilizing Air Frying treatment. The purpose of this systematic review study was to examine the use of Air Frying in Brassica vegetables to increase the content of phenolic compounds and flavonoids so that they are useful as antioxidant agents for the body.

METHOD

Research Design

The design used in this study is a systematic literature review (SLR) using the preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) method. This method is used to determine a good treatment to increase phenolic and flavonoid compounds in brassica vegetables so that these compounds can be used as antioxidant agents for the body. This systematic review can identify, evaluate, and interpret all the findings on the research topic that has been determined.

Search Strategy

A systematic review search was performed using the following academic electronic databases: Google Scholar, PubMed, Science Direct, and Manual. The search strategy involves using a variety of keywords and brassica vegetable terms to initiate a search. The first step involves using the following keywords: Brassica, Air Frying, and Antioxidants. An initial search using this term on Google Scholar resulted in 36 journals, a second search using the PubMed database yielded 1 journal and a third search using the Science Direct database yielded 4 journals and a manual search yielded 2 additional journals.

Exclusion Criteria

The study focused on increasing the content of phenolic compounds and flavonoids in brassica vegetables using the Air Frying method. A manual search of reference lists of retrieved journal articles was performed to identify additional relevant publications not captured by the online search strategy for inclusion. The study focused on the resistance of the content of phenolic compounds and flavonoids in brassica vegetables using the Air Frying method. The initial search identified 43 journals, 36 journals on Google Scholar, 1 journal on PubMed, 4 journals from Science Direct, and 2 additional journals manually. After removing the duplicates, 42 journals remained, 15 were excluded after reading the title, 10 were excluded after reading the abstract, then 3 were excluded after

reading the objectives, so that 14 journals remained, and 3 were issued again because the data was not available, 11 journals remained which were then issued 2 more journals because they were not by the theory. So that there are 9 journals remaining, and in the entire text of the 9 journals there are 4 that do not pass based on the criteria. After evaluating the references, data extraction was carried out for further discussion, then 5 journals obtained from Google Scholar, Science Direct, and Manual were filtered. then further discussion is carried out. After evaluating the references, data extraction was carried out for further discussion, then 5 journals obtained from Google Scholar, Science Direct, and Manual were filtered. then further discussion is carried out. After evaluating the references, data extraction was carried out for further discussion, then 5 journals obtained from Google Scholar, Science Direct, and Manual were filtered. then further discussion is carried out.

A flow diagram has been provided to show the number of publications identified and their eligibility evaluated (Figure 1).

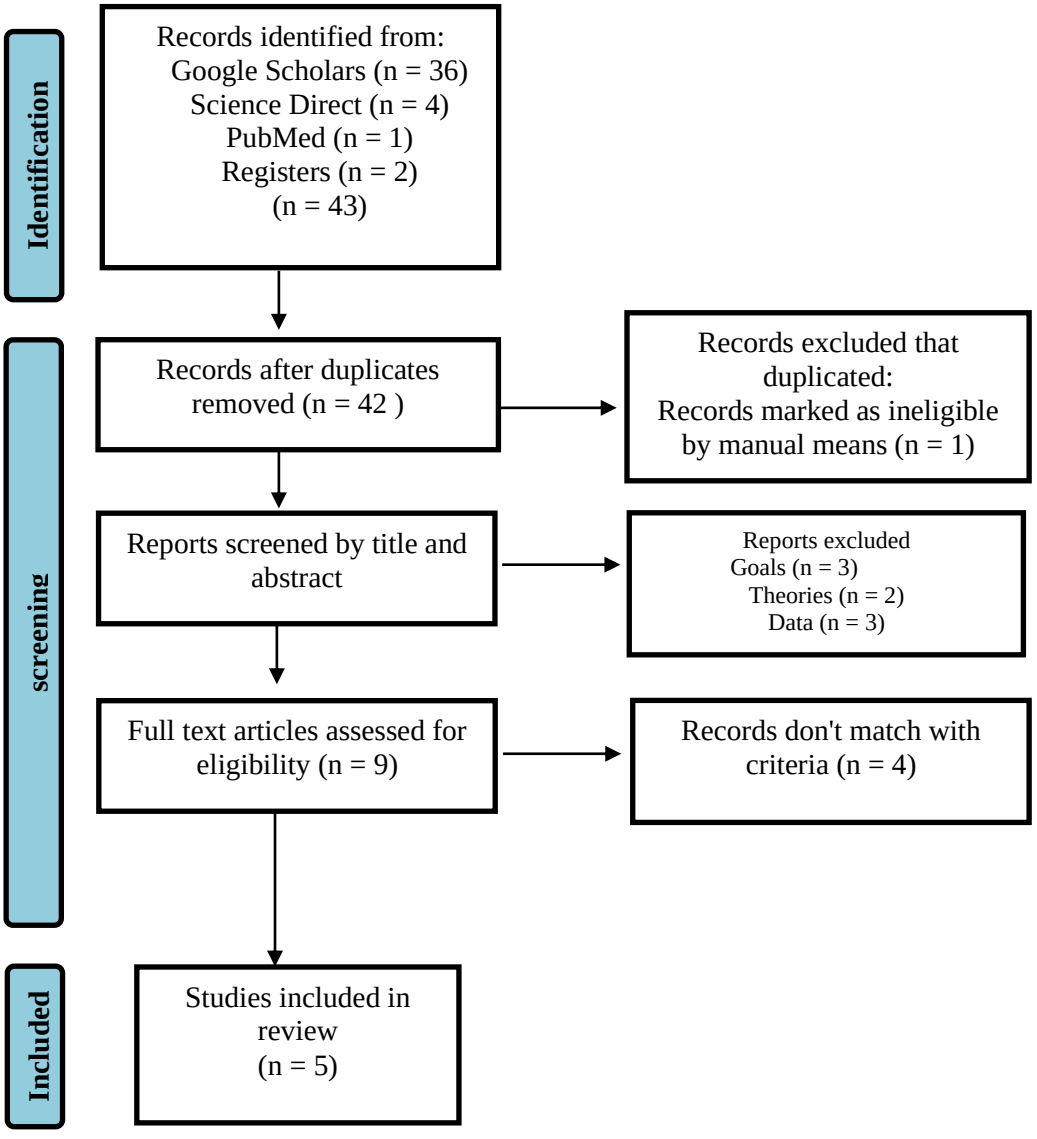

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowdiagram

RESULTS

Title	Sample	Objective	Research Place	Results	Conclusion
Thermal Processing Via Air Frying Improves the Antioxidant Properties of Brassica Vegetables. (Nandasiri et al., 2023)	Material: Five Brassica vegetables, including red cabbage, green cabbage, broccoli sprouts, bean sprouts brussels sprouts, and kale.	This study was conducted to demonstrate that air fryers can be a preferred thermal processing method sustainable way to improve Brassica Vegetable biomolecules.	Department of Food & Human Nutritional Sciences, University of Manitoba, Winnipeg, MB, R3T 2N2, Canada Division of Neurodegenerative Disorders (DND), St. Boniface Hospital Albrechtsen Research Centre, St. Boniface Hospital Albrechtsen Research Centre, 351 Tache Avenue, Winnipeg, MB, R2H 2A6, Canada Canadian Center for Agri-Food Research in Health and Medicine (CCARM), St. Boniface Hospital Albrechtsen Research Center, St. Boniface Hospital Albrechtsen Research Centre, 351 Tache Avenue, Winnipeg, MB, R2H 2A6, Canada Agriculture Agri-Food Canada, Morden Research and Development Centre, Morden, MB T1J 4B1, Canada.	1. Impact of thermal processing on total phenolic (TPC) and total flavonoid content (TFC) Phenolic compounds have been reported to contribute to taste, color and antioxidant activity plant. The Folin-Ciocalteu test determines the TPC of vegetables based on the oxidation reaction of the compound phenolic in the presence of a mixture of phosphomolybdate and phosphotungstate. The impact of the technique of Different thermal processing was evaluated for TPC. The research results show that Air frying, compared to other techniques, has more vegetable TPC significantly ($p<0.05$) regardless of the variety 2. Impact of thermal processing on antioxidant activity. Application of heat in a pressurized environment for a shorter time will inactivate the activity of the myrosinase enzyme in brassica vegetables. This phenomenon activates glucosinolates thereby increasing the antioxidant activity of thermally processed vegetables.	The current study investigates the effect of different thermal processing methods to enhance the antioxidant status of selected Brassica Vegetables. The findings show applicability of air frying improves phenolic and flavonoid status and its antioxidant potential in selected Brassica Vegetables. Sprouts of kale and broccoli show antioxidant activity highest during air fryer treatment at 160oC for 10 minutes. Observed further that the antioxidant potential of vegetables is enhanced by thermal processing.
Cooking methods affect	Diced fresh kale (Brassica	This study aims to	1.	Boiling, air frying, and	Cooking vegetables by

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eating quality, bio-functional components, anti-nutritional compounds and sensory attributes of selected vegetables (Maqbool et al., 2021)	oleraceavar. acephala L.), spinach (Spinacia oleracea L.), peas (Phaseolus vulgarisL.), carrots (Daucus carota L.) and tomatoes (Solanum lycopersicum L.).	evaluate the effect of boiling, air frying, and microwave cooking methods on the phytochemical and antinutritional activities of several vegetables.	Department of Food Technology, Islamic University of Science & Technology, India; 2. Department of Food Science & Technology, Government College for Women, MA Road, Srinagar, Jammu and Kashmir, India	microwave cooking methods describe increasing levels total phenolic content of selected vegetables. Trend of improvement the total phenolic content in selected vegetables is due to by the release of polyphenols from intracellular complexes during cooking, inactivation of the enzyme polyphenol oxidase (PPO). Release of bioactive compounds due to breakdown cell walls and increased flavonols free. Similar findings were also reported on vegetables cooked by Geetha et al. (2018), Husain et al. (2017) and Saikia and Mahanta (2013). In general, method cooking can reduce the oxalate content of vegetables compared to raw vegetables; however, frying and boiling with air heat gives a much higher reduction than cooking with a microwave. Cooking vegetables by boiling, air frying, and microwave methods significantly reduces the tannin content compared to fresh vegetables. The sensory values of boiled, air-fried, and microwave-cooked vegetables were within the acceptable range, with high process recommendations	boiling, air frying and microwaving methods showed a significant increase in bioactive components. Cooking vegetables significantly increases their phytochemical and antioxidant activity. Boiling, air frying, and microwaving vegetables significantly reduce their antinutritional components, there by reducing the bioavailability of nutrients in vegetables. Selected vegetable cooking methods increase phenolic and flavonoid content but reduce saponin, tannin and oxalate content. Phytochemicals had a positive relationship with the cooking time for the three cooking methods. Consumer acceptance of cooked vegetables was highest for the air-frying cooking method compared to boiling and microwave cooking.

Title	Sample	Objective	Research Place	Results	Conclusion
				for preparing semi-finished vegetables with good consumer acceptance.	
Impact of Cultivar Selection and Thermal Processing by Air Drying, Air Frying, and Deep Frying on the Carotenoid Content and Stability and Antioxidant Capacity in Carrots (Daucus carota L.) (Schmiedeskamp et al., 2022)	1.Plant Material. Seeds from 15 different carrot cultivars (D. carota L.) were purchased and planted in mid-February 2019 into plant pots with 5 L of soil. Of the selected cultivars, three were yellow, nine were orange, one was red, and two were purple with an orange core. 2.Chemical material. Methanol for liquid chromatography, tetrahydrofuran (HiPerSolvChromanorm, for LC-MS,≥99.7%) and dichloromethane(PESTINORM for GC capillary analysis)-mass spectrometry (LC-MS) (≥99.95%). Isopropanol (Rotisol, for HPLC,≥99.9%) was purchased from Merck KGaA (Darmstadt, Germany). Trolox and potassium persulfate, 2′-Azinobis-3-ethylbenzothiazoline-6-sulfonic acid (ABTS), 2′-Azinobis-3-ethylbenzothiazoline-6-sulfonic acid (ABTS),	To find out effects of cultivar selection and thermal treatment by air drying, frying air, and deep fryer on carotenoid content and stability and antioxidant capacity of carrots.	Leibniz Institute of Vegetable and Ornamental Crops, 14979 Grossbeeren, Germany; NutriAct Competence Cluster Nutrition Research erlin Potsdam, 14558 Nuthetal, Germany; University of Bayreuth, Faculty of Life Sciences: Food, Nutrition and Health, Food Metabolome, 95326 Kulmbach, Germany.	Antioxidant Capacity: The antioxidant scavenging capacity of carrot chips is affected by the processing method and duration. The lowest antioxidant capacity was found in samples that were air-dried and fried (18 minutes) with 2.82 mmol TE·G-1DM and 2.72 mmol TE·G-1DM. Air-dried carrot slices had lower antioxidant capacity than expected when extrapolated from the carotenoid content, which indicates degradation of other antioxidant compounds during prolonged oxygen exposure. In contrast, the antioxidant capacity of fried carrots was proportional to its fat content and inversely related to carotenoid content, thus indicating that the tocopherol antioxidant properties of absorbed frying did not match the results.	This study shows that cultivar selection and postharvest processing have a major impact on the carotenoid content and antioxidant capacity of the carrots produced. This study confirmed that air drying caused less carotenoid degradation in carrots than frying at the same degree of cooking. This increased carotenoid stability was not demonstrated in the air fryer under the presented study conditions. Thus, through careful selection of carrot cultivars and processing methods, the amount of health-promoting carotenoids in the diet can be increased substantially.
Effects of different cooking methods on the antioxidant capacity and flavonoids, organic acids and mineral contents of Galega Kale (Brassica oleracea var. acephala cv. Galega). (Armesto, et all., 2018)	Three samples of Galega kale (Brassica oleraceavar. acephala cv. Galega)	To determine the effect of different cooking methods (boiling, steaming, microwave, and vacuum cooking) and cooking time on the antioxidant capacity and content of flavonoids, organic	Area de Tecnologıa de los Alimentos, Facultad de Ciencias, Universidad de Vigo, Ourense, Spain.	Cooking causes a significant reduction in total flavonoid content. Boiling and pressure cooking at 0.55 bar produced the largest decrease, respectively 64.37–67.26% and 62.77–67.52%. Steaming resulted in the lowest losses (9.7–	The nutritional value of galega kale is high due to its antioxidant capacity and high total content of flavonoids, ascorbic acid, and high mineral elements. The oxalic acid content of kale fresh is quite high, and cooking does not cause major losses. However, the

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		acids, and minerals from Brassica oleraceavar. acephala CV. Galega, a variety of Brassica oleracea widely cultivated and consumed in northern Spain.		11.3%). Vacuum cooking results in lower losses than boiling. The lower temperature achieved in the vacuum cooked kale may have led to lower levels of cell disruption and thus less leaching compared to boiled kale. Flavonoid retention may also be favored by vacuum cooking, which reduces O22 levels and thereby minimize the oxidation process. Although the long cooking time used for vacuum cooking was higher than for boiling, the total loss of flavonoids was lower in kale cooked with vacuum. This finding can be explained by the sensitivity of the flavonoids to oxygen.	oxalate:calcium ratio is low (<2). The boiling and vacuum cooking treatments result in a potentially beneficial loss of oxalate, but also a significant loss of antioxidant capacity and nutrients such as ascorbic acid and flavonoids.
Effect of Air-Frying on the Bioactive Properties of Eggplant(Solanum melongena L.). (Solanum et al., 2021).	Black Eggplant 2 grams	To investigate the effect of air frying at different temperatures and solvents extraction on the bioactive properties of eggplant.	Department of Food Science & Nutrition, College of Food and Agricultural Sciences, King Saud University, Riyadh 11451, Saudi Arabia;	It can be seen that TFC is strongly influenced by frying time air and solvent extraction. Eggplant air field for 25 minutes and extracted with 50% ethanol (HC50) showed the highest TFC (equivalent to 35.10 mg of catechins per gram dry weight), followed by air-fried for 15 minutes and extracted with 50% ethanol (MC50).) (31.75), fried for 25 minutes and extracted with 25% ethanol (HC25) (28.30), and fried for 15 minutes and extracted with 25% ethanol (MC25) (18.75). Raw eggplant	Medium cooked samples had the highest phenolic compounds (335.5 mg/100 g) compared to high and low cooking eggplants. The raw sample showed the lowest reducing power and DPPH reduction, while activity the highest DPPH clearance was recorded for samples fried for 25 min and extracted with 50% ethanol. In addition, the raw eggplant sample has a concentration lowest phenolic compounds compared to fried eggplant samples.

Title	Sample	Objective	Research Place	Results	Conclusion
				sample own lowest concentration of phenolic compounds (13.86 mg/100 g) compared to eggplant samples fry. Medium cooked samples had the highest phenolic compounds (335.5 mg/100g) compared to highly cooked samples (216.15 mg/100g) and lightly cooked (26.92 mg/100g)	

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DISCUSSION

Brassica vegetables are a type of vegetable that is easy to find and widely consumed by Indonesian people because of their high number and variety, and relatively cheap prices. In addition, Brassica vegetables are also known for their complete phytochemical content, and high levels of nutrients such as vitamins, flavonoids, phenolics, and minerals. Moreover, this vegetable is full of important secondary metabolites such as glucosinolates, folic acid, vitamin C, selenium, carotenoids, and phenolics which are anti-cancer compounds (Ahmad Jan, 2018). Glucosinolates are a specific group of phytochemicals present in Brassica vegetables, glucosinolates are aliphatic, indolic, or aromatic, these compounds have protective effects against many types of cancer (Jin *et al.*, 2014)). One type of Brassica vegetable that is often consumed because of its health benefits is Brassica oleracea, for example, cabbage, sprouts, broccoli, kale, and so on (Nandasiri *et al.*, 2023). In general, brassica vegetables will provide good nutritional benefits when consumed raw rather than cooked. In this case, according to (Mahanta, 2012) cooking can make the phenolics and antioxidants of cooked vegetables very different from their raw form. However, some people prefer to eat Brassica vegetables that have gone through a cooking process rather than eating raw Brassica vegetables directly, because in terms of taste and texture, raw Brassica vegetables tend to be less attractive. So it is necessary to have an appropriate cooking method to minimize the loss of nutrients in brassica vegetables. Cooking methods not only affect the nutritional composition of food but also the levels of available bioactive compounds (Hossain *et al.*, 2017) Utilization of the Air Frying process Can be an alternative to minimizing the loss of nutrients in food(Zaghi *et al.*, 2019). The frying process is closely related to the use of cooking oil. The high amount of oil absorbed by food is a disadvantage of the frying process(Negara *et al.*, 2021). However, this hot air frying process hardly requires cooking oil for the cooking process, so the fat content of the food product is relatively low. This statement is also supported by (Zhu *et al.*, 2021) that the air fryer is based on hot air as a heat transfer medium and the oil used is 80% less compared to ordinary fryers or deep fryers. In addition, utilizing the Air Frying process in the processing of brassica vegetables can increase the phenolic status (TPC) and flavonoids (TFC). This increase in content has been tested in the research conducted(Nandasiri *et al.*, 2023)which optimizes the conditions of using Air Frying with lower temperatures for a shorter time, namely 160 HaiC for 10 minutes, showing much higher TPC values ranging from 1.76 ± 0.11 mg GAE/g DW (green cabbage) up to 5, 87 ± 0.23 mg GAE/g DW (broccoli sprouts). This shows that temperature also affects the content of antioxidant compounds. As described by (Mahanta, 2013) Vegetable samples cooked at medium temperature had the highest phenolic compounds (335.5 mg/100 g) compared to samples cooked at high temperatures (216.15 mg/100 g) and low temperatures (26.92 mg/100g).

Meanwhile (Maqbool *et al.*, 2021) also showed that air frying significantly increased the phenolic and flavonoid content, and significantly reduced the saponin, oxalate, and tannin content ($P<0.05$) compared to fresh vegetables. The tendency to increase the total phenolic content in vegetables such as kale is due to the release of polyphenols from the intracellular complex during cooking. This is also supported by research (Schmiedeskamp, Schreiner and Baldermann, 2022) who stated that one of the samples experienced an increase in antioxidant compounds by utilizing Air Frying.

Various thermal processing techniques, such as stir-frying, steaming, freeze-drying, and air frying, have been proven to increase the flavonoid and phenolic content of brassica vegetables regardless of the variety (Nandasiri *et al.*, 2023). This is reinforced by the research results in the article (Armesto *et al.*, 2019) demonstrated that boiling and vacuum frying resulted in a potentially beneficial loss of oxalate, but also a significant loss of antioxidant capacity and nutrients such as ascorbic

acid and flavonoids. A study (O. Mwebi and M.O. Ogendi, 2020) showed that cooking not only increased the antioxidant concentration in brassica but also increased the antioxidant concentration of paprika. A study (Hamed *et al.*, 2019) also demonstrated that these high levels of nutrients are retained in peppers even after cooking, as is evident antioxidant activity.

Another advantage of Air Frying besides being able to increase the content of antioxidant compounds in brassica vegetables is that there are also no significant differences such as taste, color, smell, appearance, hardness, or crispness between air fryers and regular fryers (Zaghi *et al.*, 2019). Even though it produces the same characteristics, the time it takes for an air fryer to achieve these characteristics is relatively longer. In processing, water content and textural properties such as hardness and crispness are the main criteria for determining food quality (Murzaini *et al.*, 2020). However, using Air Frying can also reduce preparation time before the cooking process.

CONCLUSION

The application of air frying improves the phenolic and flavonoid status and antioxidant potential of selected brassica vegetables. Sprouts, kale, and broccoli showed the highest antioxidant activity during air frying at 160oC for 10 minutes. Selected vegetable cooking methods increase phenolic and flavonoid content but reduce saponin, tannin, and oxalate content. Phytochemicals have a positive relationship with cooking time. And the other advantages of Air Frying apart from being able to increase the content of antioxidant compounds in brassica vegetables are that there are also no significant differences such as taste, color, smell, appearance, hardness, or crispiness between air fryers and regular fryers.

REFERENCES

Agiriga, A.N. and Siwela, M. (2018) 'Effects of thermal processing on the nutritional, antinutrient, and in vitro antioxidant profile of monodora myristica (gaertn.) dunal seeds', *Preventive Nutrition and Food Science*, 23(3), pp. 235–244. Available at: https://doi.org/10.3746/pnf.2018.23.3.235.

Ahmad Jan, S. (2018) 'Antioxidant and anticancer activities of Brassica rapa: a review', *MOJ Biology and Medicine*, 3(4), pp. 3–7. Available at: https://doi.org/10.15406/mojbm.2018.03.00094.

Armesto, J. *et al.* (2019) 'Effects of different cooking methods on the antioxidant capacity and flavonoid, organic acid and mineral contents of Galega Kale (Brassica oleracea var. acephala cv. Galega)', *International Journal of Food Sciences and Nutrition*, 70(2), pp. 136–149. Available at: https://doi.org/10.1080/09637486.2018.1482530.

Becker, T. and Juvik, J. (2016) 'The Role of Glucosinolate Hydrolysis Products from Brassica Vegetable Consumption in Inducing Antioxidant Activity and Reducing Cancer Incidence', *Diseases*, 4(4), p. 22. Available at: https://doi.org/10.3390/diseases4020022.

Bhandari, S.R. and Kwak, J.H. (2015) 'Chemical composition and antioxidant activity in different tissues of brassica vegetables', *Molecules*, 20(1), pp. 1228–1243. Available at: https://doi.org/10.3390/molecules20011228.

Fikry, M. *et al.* (2022) ' Development of Mathematical Models for Predicting Mass Transfer and Changes in Quality Properties of Falafel Prepared from Faba Bean (Vicia faba L.) by Air Frying Technique ', *Journal of Biobased Materials and Bioenergy*, 16(1), pp. 150–158. Available at: https://doi.org/10.1166/jbmb.2022.2162.

Hamed, M. *et al.* (2019) 'Capsaicinoids, polyphenols and antioxidant activities of Capsicum annuum: Comparative study of the effect of ripening stage and cooking methods', *Antioxidants*, 8(9). Available at: https://doi.org/10.3390/antiox8090364.

Hossain, A. *et al.* (2017) 'Enhancement of antioxidant quality of green leafy vegetables upon different cooking method', *Preventive Nutrition and Food Science*, 22(3), pp. 216–222. Available at:

https://doi.org/10.3746/pnf.2017.22.3.216
.

Jin, X. *et al.* (2014) 'Impact of different drying trajectories on degradation of nutritional compounds in broccoli (Brassica oleracea var. italica)', *Lwt*, 59(1), pp. 189–195. Available at: https://doi.org/10.1016/j.lwt.2014.05.031.

Mahanta, C. (2012) 'Effect of steaming, boiling and microwave cooking on the total phenolics, flavonoids and antioxidant properties of different vegetables of Assam, India'. Available at: www.ijfans.com/currentissue.html.

Maqbool, N. *et al.* (2021) 'Cooking methods affect eating quality, bio-functional components, antinutritional compounds and sensory attributes of selected vegetables', *Italian Journal of Food Science*, 33(SP1), pp. 150–162. Available at: https://doi.org/10.15586/IJFS.V33ISP1.2092.

Murzaini, N.M.N. *et al.* (2020) 'Effect of pre-treatment in producing pumpkin powder using air fryer and its application in "Bingka" baking', *Current Research in Nutrition and Food Science*, 8(1), pp. 48–64. Available at: https://doi.org/10.12944/CRNFSJ.8.1.05.

Nandasiri, R. *et al.* (2023) 'Thermal Processing via Air Frying Improves the Antioxidant Properties of Brassica Vegetables', (February), pp. 1–20. Available at: https://doi.org/10.20944/preprints202302.0021.v1.

Negara, B.F.S.P. *et al.* (2021) 'Article application of deep, vacuum, and air frying methods to fry chub mackerel (Scomber japonicus)', *Processes*, 9(7), pp. 1–14. Available at: https://doi.org/10.3390/pr9071225.

O. Mwebi, N. and M.O. Ogendi, B. (2020) 'Effect of boiling, steaming, stir-frying and microwave cooking on the antioxidant potential of peppers of varying pungency', *Cogent Food and Agriculture*, 6(1). Available at: https://doi.org/10.1080/23311932.2020.1834661.

Schmiedeskamp, A., Schreiner, M. and Baldermann, S. (2022) 'Impact of Cultivar Selection and Thermal Processing by Air Drying, Air Frying, and Deep Frying on the Carotenoid Content and Stability and Antioxidant Capacity in Carrots (Daucus carota L.)', *Journal of Agricultural and Food Chemistry*, 70(5), pp. 1629–1639. Available at: https://doi.org/10.1021/acs.jafc.1c05718.

Solanum, L. *et al.* (2021) 'Effect of Air-Frying on the Bioactive Properties of Eggplant'.

Wang, Y. *et al.* (2021) 'Effect of new frying technology on starchy food quality', *Foods*, 10(8). Available at: https://doi.org/10.3390/foods10081852.

Zaghi, A.N. *et al.* (2019) 'Frying Process: From Conventional to Air Frying Technology', *Food Reviews International*, 35(8), pp. 763–777. Available at: https://doi.org/10.1080/87559129.2019.1600541.

Zhu, Z. *et al.* (2021) 'Air frying combined with grape seed extract inhibits Nε-carboxymethyllysine and Nε-carboxyethyllysine by controlling oxidation and glycosylation', *Poultry Science*, 100(2), pp. 1308–1318. Available at: https://doi.org/10.1016/j.psj.2020.11.056.