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OPTIMISATION OF THE MIXTURE OF ACTIVATED CHARCOAL AND RED GINGER EXTRACT WITH THE ADDITION OF SANSEVEIRA TO THE FOOD CABINET FILTER

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ABSTRACT: Spoiled or unhealthy food is the causative agent of a disease called ptomaine poisoning. This disease can come from consuming water, milk, other drinks, and food in raw or cooked form provided in a place that contains agents that can produce disease in sufficient quantities, an amount needed to cause various diseases. Various agents that can cause disease in food are plants, bacteria, chemicals, animals, agents that use food to transfer themselves, radionuclides, and microbes. Food damage caused by microbes is usually due to the condition of the food, which has a high water content and improper storage of food on types of food that are not durable. Microbes that cause harm can come in various ways from slime molds, yeasts, bacteria, and viruses. It can come from polluted air and cross-contamination from food storage areas. The purpose of this research is to make an air filter in a food storage cupboard that can inhibit the growth of pathogenic microbes so that the stored food is not easily damaged. The method of implementation in this study was to make a filter mixture composed of activated charcoal from bamboo ori, sanseviera, and red ginger extract, where the material has anti-bacterial and antiviral benefits. The filter composition to be tested is a mixture of activated charcoal, sanseviera, and ginger extract. red in the ratio: 3:1:4; 4:1:4; 4:1:3; 2:2:4; 4:2:4; 4:2:2, samples containing protein. The best results that can inhibit the growth of Bacillus substillis are obtained in filters with a composition of 4:2:4.

Keywords: air filter, food storage cupboard, red ginger, sansevieria, ori bamboo charcoal

1. Introduction

Food as a source of nutrition needs to be kept healthy by utilising proper storage, presentation and packaging. Food cannot appear in the best and most beneficial conditions. Therefore, proper processing, serving and storage are necessary to prevent spoilage. Foods that are consumed as nutrients that are taken every day are primarily classified as types of food that are not durable and are stored in food cupboards mixed with other ingredients. Microbes can cause damage to food stored in the cupboard at room temperature. Usually, those that cause food spoilage are slimy moulds, yeast fungi, bacteria, viruses, rickettsiae, and protozoa. Bacteria can cause disease, which can be transmitted through food media by multiplying until they are abundant in food, causing infection or food poisoning.

The results of research on the use of filters for food cabinets concluded that there were differences in the quality of food before using filters and those who used them. Food cabinets that do not use filters on food samples quickly grow salmonella, staphylococcus, and bacillus microbes, which can cause infectious and toxic diseases. Foods that drive the growth of bacteria are natural protein, high humidity, high osmotic pressure, oxygen pressure, acidity and temperature. One way to keep perishable food from spoiling over time is to need a room that can be conditioned so that the bacterial growth factors are as small as possible, in addition to adding food additives that function as food preservatives. The use of food additives requires a unique understanding that is quite long for ordinary people because of the increasing variety of types. Therefore, innovation is needed for food storage cabinets. Current food storage cabinets use refrigeration machines, airtight rooms, or sterile rooms, which are pretty expensive and are not equipped with air purifiers in these rooms. Air purifiers are currently widely used for residential spaces, and the latest are high-efficiency particulate air filters (HEPA). However, apart from being quite expensive, this system still has to be combined with Ultra Violet Germical Irradiation (UUGI) or those still being researched using plasma cluster ions [1,2,3].

The current condition of society requires a food storage cupboard, which is quite cheap and easy to operate. Still, the food is not perishable, simple and can be made by yourself using natural materials based on local wisdom [4,5]. Therefore, this research aims to make air filters for food storage cabinets that can absorb odours and moisture and inhibit pathogenic microbes' growth so that food does not spoil quickly. The air filter made in this study is a briquette plate made from a mixture of activated charcoal, red ginger extract, and Sanseviera powder. Activated charcoal comes from bamboo because charcoal from bamboo can be rejuvenated naturally under sunlight for one hour after one month of use and has a very high surface area, very irregular pore structure measuring 5-500 angstroms and is non-polar which allows it to adsorb various chemicals [6,7]. Each part of the bamboo stem of the same type has different specific gravity and yield. Charcoal from the bottom of the stem of all kinds of bamboo shows a high specific gravity and yield, and the higher up, the lower it8, therefore in this study using bamboo from the bottom up to 2/3 of the bamboo height.

Sanseviera, known as Mother-in-law's tongue, is a tropical plant with secondary metabolites that can inhibit microbial growth and absorb odours, namely alkaloids, allicin, saponins, and glycosides [8,9]. The red ginger rhizome contains gingerol and shogaol compounds, zingerone, which has benefits as an antioxidant, non-mutagenic, anti-carcinogenic, and reduces cardiotonic and antitussive activity [10,11]. Ginger rhizome essential oil 1%, especially red ginger, has sesquiterpene secondary metabolites that can inhibit the growth of avian influenza and influenza viruses [12,13,14,15]. Staphylococcus aureus in an amount of 106 – 108 CFU/ml causes poisoning because it produces enterotoxins as well as escherichia coli, which causes nausea, vomiting, and diarrhea16 so that when combined, it can inhibit the growth of bacteria and viruses.

2. Research Methods

Ori bamboo and red ginger were obtained from the preset area, and sansevieria was obtained from the Batu Malang Raya area. Making air filters for food storage cabinets goes through 4 (four) stages, namely making activated charcoal from bamboo or with a size of 100mesh, making sansevieria dry powder, making red ginger extract, and making filters with a mixture of activated charcoal: sanseviera: ginger extract are: 3 :1:4 ; 4:1:4 ; 4:1:3 ; 2:2:4 ; 4:2:4 ; 4:2:2. and printed in size 20 x 20 cm with a pressure of 100 bar for 10 minutes. The printed filter was left in open air for 30 minutes and then dried in a dehydrator for 5 hours at 40°C. The dry filter is packaged in aluminium foil and plastic vacuum.

Test the filter's effectiveness by using samples containing protein, namely tempeh and tofu, four samples per filter. Observations were carried out for six days. Sample analysis was carried out using moderate organoleptic and microbial tests for filters using SEM EDX to determine whether there was a change in the inorganic mineral content in the filter after the trial.

Table 1 Weight Change of various filter

Observation	Filter Ratio(activated charcoal: ginger rhizome: sansevieria)					
	3:1:4	4:1:4	4:1:3	2:2:4	4:2:4	4:2:2
initial weight (gram)	146	181	139	161	168	164
final weight (gram)	168	216	168	197	178	192
Filter weight increase (gram)	22	35	29	36	10	28
Tempe weight loss 1 (gram)	9	9	17	22	20	18
Tempe weight loss 2 (gram)	12	15	7	16	16	15
Tofu weight loss 1 (gram)	20	30	19	31	32	31
Tofu weight loss 2 (gram)	19	17	11	24	23	27
Decrease in total sample weight (gram)	60	71	54	93	91	91
Particles/minerals that can be absorbed by the filter (%)	36,67%	49,30%	53,70%	38,71%	10,99%	30,77%

3. Result and Discussion

The change in filter and sample weight in Table 1 shows that the filter can absorb sample particles/minerals, but not all of the particles/minerals in the sample will be absorbed by the filter. The filter's absorption of particles/ minerals depends on the filter composition. The filter with the most considerable particle/mineral absorption has a composition ratio of activated charcoal: sanseviera: ginger extract of 4:1:3, with an absorption percentage of 53.70%.

Table 2 Microbial Growth In Food Storage Cabinets Equipped With Air Filters

Observation		Filter Ratio (activated charcoal: ginger rhizome: sansevieria)					
		3:1:4	4:1:4	4:1:3	2:2:4	4:2:4	4:2:2
Unfiltered sample Types of microbes that grow: coccus and rhizopus with a total of 2,000,000 colonies/100mL, there are lots of maggots and a very pungent odour							
Sample with filter							
a	Tempe 1	Bacillus Subtillis/MPN 0,03	Bacillus Subtillis/MPN 0,61	Bacillus Subtillis/ MPN 0,15	Bacillus Subtillus/ MPN 0,092	Bacillus Subtillis/ MPN 0,03	Bacillus Subtillis/ MPN 0,75
b	Tempe 2	Bacillus subtillis/ MPN 0,11	Bacillus Subtillis/ MPN 0,26	Rhizopus/ MPN 0,20	Bacillus Subtillis/ MPN 2,10	Bacillus Subtillis/ MPN 0,06	Staphylococcus/ MPN 0,61
c	Tofu 1	Bacillus Subtillis/ MPN 4,60	Bacillus Subtillis/ MPN 0,15	Bacillus Subtillis/ MPN 0,11	Bacillus Subtillis/ MPN 0,03	Bacillus Subtillis/ MPN 0,06	Bacillus Subtillis/ MPN 0,03
d	Tofu 2	Streptococcus/ MPN 0,15	Bacillus Subtillis/ MPN 0,03	Bacillus Subtillis/ MPN 0,15	Bacillus Subtillis/ MPN 0,15	Basillus Subtillis/ MPN 0,03	Bacillus Subtillis/ MPN 0,61

Table 3 Filter Test Results Data Using SEM EDX

Particle	**Filter Ratio (activated charcoal: ginger rhizome: sansevieria)**											
	3 : 1 : 4		4 : 1 : 4		4 : 1 : 3		2 : 2 : 4		4 : 2 : 4		4 : 2 : 2	
	Before (%)	After (%)	Before (%)	After (%)	Before (%)	After (%)	Before (%)	After (%)	Before (%)	After (%)	Before (%)	After (%)
C	43.76	52.45	43.32	2.63	22.44	31.73	40.8	24.9	3.32	41.24	21.31	26.05
O	34.24	39.33	33.03	1.77	12.68	20.61	30.29	21.19	2.37	38.39	17.67	19.46
Sc	-	-	-	-	-	-	-	-	-	12.01	-	-
S	2.96	1.91	2.06	0.11	-	-	1.52	1.08	0.14	1.68	1.16	0.9
Cl	2.76	5.61	6.07	0.44	5.75	5.44	4.65	5.41	0.12	2.13	4.73	4.39
Si	1.76	0.56	-	-	-	1.35	-	-	0.1	3.77	-	-
Na	-	-	0.05	0.05	-	-	-	0.56	0.04	0.25	0.45	0.46
Ca	-	-	-	0.69	6.48	7.04	-	6.24	-	-	-	8.63
I	-	0.02	-	-	-	-	-	-	-	-	-	-
Te	-	0.02	-	-	-	-	-	-	-	-	-	-
Cs	-	0.02	-	-	-	-	-	-	-	-	-	-
Tl	-	0.02	-	-	-	-	-	-	-	-	-	-
Mg	-	-	-	0.22	-	0.56	-	-	-	-	-	-
Cr	-	-	-	0.05	-	-	4.01	1.56	-	0.53	-	-
Ta	-	-	-	-	-	-	-	1.25	-	-	-	-

Based on the data in Table 2 above, when the sample was stored in a food storage cupboard without a filter, microbes with a colony count of 2,000,000/100 mL of sample were obtained. The microbes formed are coccus types that tend to be pathogenic. In addition to the emergence of pathogenic microbes, food spoilage occurred with the emergence of quite a lot of larvae as a result of the decay of the sample protein. The air in food storage cabinets is easily polluted because moisture is followed by the decomposition of food by microbes. By adding air filters with varying compositions of activated charcoal, sanseviera extract, and ginger extract, in general, the growth of microbes can be suppressed. The ratio of the composition of activated charcoal: sansiviera extract and ginger extract is the best air filter in a ratio of 4: 2: 4. At this ratio, the growth of the bacillus subtillis bacteria can be inhibited (the growth is very small) compared to the ratio of other air filter compositions. This is indicated by the growth of microbes other than bacillus subtillis which are pathogenic with quite high MPN values. The addition of an air filter as an anti-bacterial and antiviral agent in the food storage space is very effective in reducing the growth of microbes and can also absorb moist air and food can last for 6 days odor-free. The bacillus subtillis bacteria is difficult to remove because it can survive at temperatures of -5°C – 75°C with a pH of 2 – 8, where the humidity is quite high, and protein samples are a carbon source [1,3,4,7,8,9,17,18].

Carbon, Oxygen, Sulfur particles in the filter with a ratio of 4:2:4 experienced a large increase. The addition of these particles probably came from the protein in the sample, which had decomposed and was in the form of a gas so that it would be attracted to the filter. The impact of reduced carbon in the filter with a ratio of 4:2:4 resulted in inhibited growth of bacillus substilis.

4. Conclusion

Sanseviera can optimise the performance of food cupboard filters and can be used as a filter component which has the characteristic properties of strengthening filter constituent bonds so that filters are not easily destroyed when absorbing water, can inhibit the growth of pathogenic microbes with certain compositions, food storage space for 6 days free from the smell though bacillus subtillis grows.

References

[1] S. Astuti. F. Endah R, Praswanto, D. H. 2021. The Effect of Ori Bamboo Charcoal Active Composition and Red Ginger on the Bacterial and Virus Growth Activities in Air Filter of Food Storage Cabinets. Journal of Science and Applied Engineering

[2] Medical Advisory secrerariat, 2005. Air Cleaning Technologies: An Evidence – based analysis. Ontario Health Technology Assessment series 2005: 5(17)

[3] David A, Christopherson, William C, Yao, Mingming, et all.2020. High – Efficiency Particulate Air Filters in The Era of Covid-19 : Function and Efficiency. Otolaryngologi-Head and Neck Surgery 2020, Vol. 163(6):1153-1155

[4] Fross WS.2005. Anti Microbial Fiber and Fibrous Products. US6946196B2

[5] Hendra D. 2006. Pembuatan Arang Aktif dari Tempurung Kelapa Sawit dan Serbuk Kayu Gergaji Campuran. Ejournal.forda-mof.org Vol.24 No.2 tahun 2006 E-ISSD 2442-8957; P-ISSN 0216-4329

[6] Lempang M.2014. Pembuatan dan penggunaan arang aktif. Info Teknis EBONI Vol. 11 No.2 Desember 2014:65-80

[7] Taman Bambu Nusantara,2012. Arang Aktif Bambu Lebih Baik dari Kayu dan Batok Kelapa.Unusantara.blogspot.com

[8] Saiful Huda, Rita Dewi Ratnani dan Laeli Kurniasari, 2020. Karakterisasi Karbon Aktif dari Bambu Ori (Bambusa Arundinacea) yang Diaktivasi Menggunakan Asam Clorida (HCl). Jurnal Inovasi Teknik Kimia Vol.5 No.1

[9] Ikewuchi CC, Ayalogu EO, Onyeike EN, dan Ikewuchi JD. 2011. Study on Alkanoid, Allicin, Glycocide and Saponin Compisition of The Leaves of Sanseviera Liberica Gerome and Labroy by Gas Chromatography. The Pacific Journal of Science and Technology, 122:367-373

[10] Ravindran P, Babu KN, 2005. Ginger: The Genus Zingiber, Washington DC: CRC Press.

[11] Syahriandi A,2011. Analisis Kandungan Minyak Atsiri Pada Rimpang Tanaman Jahe Zingiber Officinale Rosc.) yang Diinduksi Dengan Fungi Mikoriza Arbuskula (FMA). Fakultas Farmasi, Universitas Andalas, Padang.

[12] Tri Untari, Sitarina Widyarini,Michael Haryadi Wibowo,2012. Aktivitas Antiviral Minyak Atsiri Jahe Merah Terhadap Virus Flu Burung. Jurnal Veteriner Vol. 15(3):309-312

[13] Nailah Nurjihan Ulfah, Mutakin,2017. Review: Aktivitas Antivirus Ekstrak Lima Tanaman Rimpang Terhadap Penghambat Virus Influenza

H5NI Dengan Metode Invitro. Jurnal Farmaka Vol.15(3):153-161

[14] Lee hs,S.S Kim, K.J Hong Hs, S.S.Lim,J.S Lee, E.J. Hong,2008. Antiviral Effect of Ingenol and Gingerol During HIV-I Replication in MT 4 Human T Lymphocytes. Antiviral Res. 12:34-37

[15] Lee, S.,Khoo, C. halstead, C.W.,Huynh,T.,Bebsoussan, A, 2008. Anti Viral Effect of Gingerol During HIV-I Ireplication In MT4 Human T Lymphocytes. Anti Viral Research (78):A1-A76

[16] Yessy F, Vriezka M, Novi PH, Surismayanti, Ibrenaita G , 2019. Antibacterial Activity of lidah Mertua (Sanseviera Trifasciata Prain) Leavest Extract on Eschericia Coli and Staphylococcus Aureus. Herbal Medicine in Pharmaceutical and Clinical Sciences. ID Design Press Macedonian Journal of Medical Sciences 2019 Nov 30; 7(22):3882-3886 Https://doi.org/10.3889/oamjms.2019.525 eissn:1857.9655

[17] Elad, Y , S. Freeman,2002. Biological Control of Fungae Plant Pathogen.pp.92.109. Ir. Kemken (ed). The Mycota XI Agricultural Aplication. Springer Verlag, Berlin.

[18] Sumantha, A.,C Larroche, A Pandey, 2006. Microbiology and Industrial of Food – Grade Proteases : A Perspective Food Technology Bio Technology 44(2):211-220