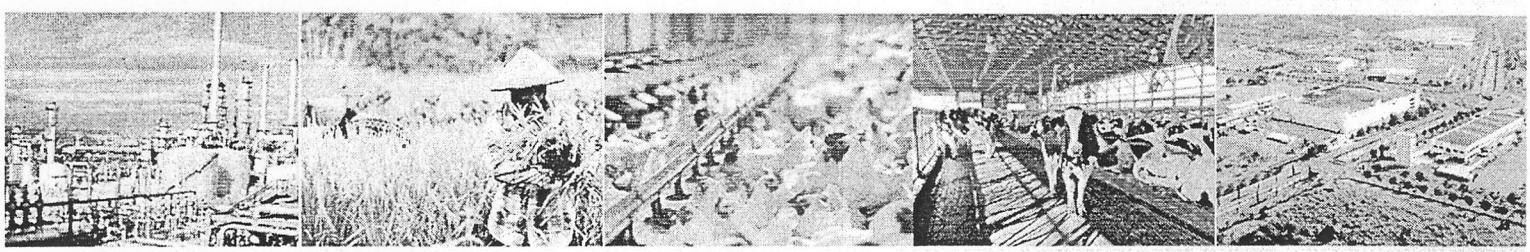
PROCEEDINGS

2015 3rd International Conference on Adaptive and Intelligent Agroindustry (ICAIA)

ICAIA 2015



August 3rd - 4th, 2015
IPB International Convention Center
Bogor, Indonesia

ISBN : 978-1-4673-7404-0
IEEE Catalog Number : CFP15C67-CDR

IEEE
INDONESIA SECTION

Proceedings of

2015 3rd International Conference on Adaptive and Intelligent Agroindustry (ICAIA)

IPB International Convention Center, Bogor, Indonesia

August 3rd – 4th, 2015

Published by :

Department of Agroindustrial Technology

Bogor Agricultural University

Bogor, Indonesia

Welcome Message from The General Chairs of ICAIA 2015

On behalf of the organizing committee, it is our pleasure to welcome you to International Conference on Adaptive and Intelligent Agroindustry, Bogor, Indonesia. This is the 3rd conference on the topic that is held by the Department of Agroindustrial Technology, Bogor Agricultural University, Indonesia.

The conference is expected to provide excellent opportunity to meet experts, to exchange information, and to strengthen the collaboration among researchers, engineers, and scholars from academia, government, and industry. In addition, the conference committee invited five renowned keynote speakers, i.e. Prof Irawadi from Bogor Agricultural University; Prof Kenneth De Jong from George Mason University, USA; Dr Yandra Arkeman from Bogor Agricultural University; and Dr Guillermo Baigorria from University of Nebraska-Lincoln, USA.

The conference committee also invited Prof Noel Lindsay from University of Adelaide, Australia; Kiyotada Hayashi from National Agricultural Research Center-Tsukuba, Japan; Prof Margareth Gfrerer from Islamic State University of Jakarta, Indonesia; Dr Barry Elsey from University of Adelaide, Australia; Dr Gajendran Kandasamy from Melbourne University, Autralia; and Imperial College London-British, Prof Allan O'Connor from University of Adelaide, Australia; Dr Wisnu Ananta Kusuma from Bogor Agricultural University ,Indonesia; and Dr Frank Neumann from University of Adelaide, Australia, as invited speakers.

This conference was organized by Department of Agroindustrial Technology, Bogor Agricultural University and Asosiasi Agroindustri Indonesia, and technically sponsored by IEEE Indonesia Section. Furthermore, it was supported by Departement of Computer Science, Bogor Agricultural University; Surfactant amd Bionegergy Research Center; PT Bogor Life Science and Technology; Indonesian Ministry of Industry; PT Pachira Distrinusa; and PT Kelola Mina Laut.

I would like to take this opportunity to express my deep appreciation to the conference's committee members for their hard work and contribution throughout this conference. I would like to thank authors, reviewers, speakers, and session chairs for their support to participate in the Conference. Lastly, I would like to welcome you to join ICAIA 2015 and wish you all an enjoyable stay in Bogor.

Sincerely,
Dr Yandra Arkeman
General Chairs, ICAIA 2015

WELCOMING ADDRESS

Prof. Dr. Ir. Nastiti Siswi Indrasti
Head of Agroindustrial Technology Department
Faculty of Agricultural Engineering and Technology
Bogor Agricultural University
on
3rdInternational Conference on Adaptive and Intelligence Agroindustry (3rd ICAIA)
Bogor, August, 3 – 4, 2015

Assalamu'alaikum Warohmatullahi Wabarokatuh
In the name of Allah, the beneficent and the merciful,

Distinguish Guest, Ladies and Gentlemen
Let me first thank you all for accepting the invitation to participate in this 3rd International Conference on Adaptive and Intelligence Agroindustry (ICAIA). In particular I would like to thank Rector of IPB (Institut Pertanian Bogor/Bogor Agricultural University) Prof. Herry Suhardiyanto for supporting this event as part of the series academic event in celebrating the 52nd Anniversary of Bogor Agricultural University.

We are certainly proud to have been able to assemble this event in IPB, Bogor. The range of participants and audience at this conference is precisely something I would like to stress. Participants who followed the event more than 150 people, coming from various countries including the USA, Australia, Japan, Vietnam, Philippine, Germany and Indonesia. The main goal of the conference is to provide an effective forum for distinguished speakers, academicians, professional and practitioners coming from universities, research institutions, government agencies and industries to share or exchange their ideas, experience and recent progress in Adaptive and Intelligent Agroindustry.

The 2015 3rd International Conference on Adaptive and Intelligent Agro-industry (ICAIA) is the third forum for the presentation of new advances and research results on various topics in all aspects of innovative agro-industry that highlights the development and improvement for today and tomorrow's global need for food, energy, water and medicine. The aim of the conference is to stimulate interaction and cohesiveness among researchers in the vast areas of innovative agro-industry. Innovative Agro-industry has the ability to adapt intelligently to future global challenges, i.e. food, energy, water, and medical. Global challenges needs a new breed of Agroindustry which could produce innovative products to fulfill the needs through advanced processing technology, production systems and business strategy supported by cutting-edge information and communication technology.

The topic for this event is "Empowering Innovative Agroindustry for Natural Resources, Bioenergy and Food Sovereignty". The topics clustered into four main parts:
Track 1 : Innovative Agroindustrial and Business System Engineering

Track 2 : Frontier Approaches in Process and Bioprocess Engineering
Track 3 : Frontier Approaches in Industrial Environmental Engineering
Track 4 : Intelligent Information and Communication Technology for Adaptive Agroindustry of the Future

This event also hosts four (4) workshops: (1) Strategies for Agroindustry Development (2) LCA for Agroindustry (3) Innovation and Technopreneurship for Agroindustry and (4) Agroindustry Informatics.

Distinguish Guest, Ladies and Gentlement,
Agroindustry transforms agricultural commodities into high value-added products. Agroindustry is industry that process agricultural products to increase their value added significantly by using technology and by considering environmental aspect and sustainability. However, with changing global demand and technology advancement, innovative agroindustry is needed in order to be competitive as well as sustainable. The challenge of future agroindustry is not merely efficiency and productivity anymore, but also the challenge to appropriately apply frontier technology as well as meeting future global demands.

Agroindustry needs to deal with the application of advance technologies and cope future global issues. Current global issues which arise and expected to exist in the future are food sovereignty, renewable energy, sustainable water management and pharmacy. The ability of agro-industry to respond the future global issues and the undoubtedly substantial increase in demand in future decades will be highly dependent on the increased application of existing technologies as well as the exploitation of new and innovative technologies.

The emergence of high technology could be applied in the agro-industry are: nanotechnology, biotechnology, bioinformatics, food processing, food packaging-waste, state-of-the-art computation and many others. The aforementioned high-technology along with computation technology could greatly advance agro-industry from a traditional system into a smart-intelligent and innovative technology. Therefore, in the new millennia, adaptive-intelligent and innovative agro-industry will contribute to solutions to global problems and brings agriculture into perfection.

Hope this conference will also discuss this issue in more detail as it is an important matter for all of us. We should no more think just how to produce high value product but it is also necessarily important how to keep our live in good quality by understanding following old saying... "You do not live at once. You only die once and live every day".

I do not to take up any more of your time with these opening remarks. Let me simply thank you once again for sharing your thoughts with us. Here's wishing every success for the conference. May Allah bless all of us.

Thank you for your kind attention,
Wassalamu'alaikum Warohmatullahi Wabarokatuh

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AGENDA

Time	Activities
Monday, August 3rd 2015	
08.00 - 09.00	Registration
09.00 - 10.00	Opening Ceremony • Welcoming Address: Prof. Nastiti Siswi Indrasti (Head of DAT, Fateta, IPB) • Welcoming Speech Head of Bogor Regency • Conference Opening: Prof. Herry Suhardiyanto (Rector of IPB) • Opening Speech and Conference Opening : Minister of Industry Indonesia * • Launching Expose International program DAT
10.00 – 10.05	*Photo Session*
10.05 - 10.15	*Coffee break*
10.15 - 10.45 10. 45 - 11.30 11.30 – 12.00 12.00 – 12.30	Keynote Speech : 1. Prof Irawadi (Bogor Agricultural University, Indonesia) 2. Prof. Kenneth De Jong (George Mason University, USA) 3. Dr. Yandra Arkeman (Bogor Agricultural University, Indonesia) 4. Dr. Guillermo Baigorria (University of Nebraska, Lincoln, USA)
12.30 – 13.30	Lunch break
13.30 – 13.50 13.50 – 14.10 14.10 – 14.30 14.30 – 14.50 14.50 – 15.10 15.10 – 15.45	Plenary Session 1 : Prof. Noel Lindsay (University of Adelaide, Australia) Dr. Kiyotada Hayashi (National Agricultural Research Center, Tsukuba, Japan) Prof. Margareth Gfrerer (Islamic State University of Jakarta, Indonesia) Dr. Barry Elsey (University of Adelaide, Australia) Ir. M. Novi Saputra (Marketing Director KML Food Group) *Discussion*
15.30 – 15.45	*Coffee break*
15.45 – 18.00	Parallel session A, B and C
18.00 – 21.00	Welcome Dinner

Time	Activities
Tuesday, August 4rd 2015	
08.30 – 09.00	Registration
09.00 – 09.20	Plenary Session 2 : Dr. Gajendran Kandasamy (PhD in Physic, Melbourne University ; PhD in Innovation Imperial Collage, London)
09.20 – 09.40	Prof. Allan O'Connor (University of Adelaide, Australia)
09.40 – 10.00	Dr. Eng. Wisnu Ananta Kusuma, ST, MT (Bogor Agricultural University, Indonesia)
10.00 – 10.20	Dr. Frank Neumann (University of Adelaide, Australia)
10.20 – 10.45	*Discussion*
10.45 – 13.00	Parallel Session A, B and C
13.00 – 14.00	Lunch break
14.00 – 15.30	Parallel Workshop • Strategies for Agroindustry Development • LCA for Agroindustry • Innovation and Technopreneurship for Agroindustry • Agroindustrial Informatics
15.30 – 15.45	Coffee Break
15.45 – 16.15	Closing remark

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 ISBN : 978-1-4673-7404-0

Identification of *phenol red* as *Staphylococcus aureus* indicator label

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Abstract

Staphylococcus aureus is one microorganism which caused food-borne disease. This bacteria contamination is very easy due to it exists in air, dust and contaminated equipment. Food contamination can occur during or after handling process such as on meat products, chicken, milk, fermented food items, vegetables, fish products and etc. The bacteria can cause food poisoning, so it is necessary to detect the growth of this bacteria in the food and food product before it is consumed. *Staphylococcus aureus* on food products can be detected using label indicator by the label color changing. The label was attached inside the food package. Many potential media can be used as label material. One of them is mannitol salt agar (MSA). MSA can give information *Staphylococcus aureus* growth on product by color changing from red to orange and yellow. This changing is irreversible. The color changing occur due to volatile acid and mannitol fermentation on MSA by *Staphylococcus aureus* result on pH reducing of the media, and then, once it will change *phenol red* color containing in MSA turn to orange and then yellow. The objective of research was to identify MSA media as *Staphylococcus aureus* detection label. The examination was conducted on petri dish approximately 2 cm from *Staphylococcus aureus* culture. The capability of label on detection *Staphylococcus aureus* growth was starting from 516 per gram of colony. The color change from red (R (red) 55, G (Green) 44 dan B (Blue) 41) to orange (R (red) 47, G (Green) 38 dan B (Blue) 34).

Key word : *Staphylococcus aureus*, color indicator, mannitol salt agar (MSA)

1. Introduction

Smart or intelligent packaging is a package that monitors the condition of the packed food to provide information about the quality during storage, transportation and distribution (Kuswandi *et al* 2011). The intelligent systems monitors the quality of the food product or its surrounding environment to predict or measure the safe shelf-life better than a best-before-date (Jong *et al* 2005). Some of smart or intelligent packaging have conducted such as smart packaging of erpa indicator (Nofrida *et al* 2013), smart packaging of natural or synthetic color (Warsiki and putri 2012), smart packaging of monitoring fishery spoilage (Pacquit *et al* 2007), smart packaging to monitor spoilage (Napwinyouwong *et al* 2010). Smart or intelligent packaging was being developed is color indicator to detect pathogen bacteria. Smart or intelligent packaging use label that can give information about microbial growth by color change. Label color will change as a result of the reaction between color compound in label to bacteria metabolites produced. This kind of label is potential to be applied for meat and meat product which spoil sensitive to microbial growth such as *Staphylococcus aureus*.

Staphylococcus aureus is Gram positif bacteria. It survivals at low aw (0.83 to 0.86), high salt concentrations up to 20%, and within a wide pH (from 4 to 10, with an optimum of 6 to 7), and temperature range (6 to 48,5°C, with an optimum of 35 to 41°C). That characteristic cause *Staphylococcus aureus* easy to growth in all of conditions. Growth of *Staphylococcus aureus* on food products can be detected using label indicator by the label color changing. The label was attached inside the food package.

Many potential media can be used as label material. One of them is mannitol salt agar (MSA). MSA is selective media and differential to *Staphylococcus aureus* growth. MSA contain *phenol red* as color indicator, mannitol and protein that to be nutrition of *staphylococcus aureus* growth. MSA also contain high salt concentration so can inhibit other microbial growth (Kateete *et al* 2007). *Phenol red* can change MSA color from red (alkali) to yellow (acid) due to pH change. The ability of color change MSA needs to be examined in its ability to detect pathogen microbial.

This paper used MSA as label component which was tested in *staphylococcus aureus* culture TSA (*tryptone soya agar*) medium by using MSA as pathogen indicator. This label will detect base in decrease of pH due volatile metabolite gas that produced by *staphylococcus aureus* and label contaminated by *staphylococcus aureus* so mannitol label fermented to acid, and then change the color of label.

2. Material and Method

2.1. Material

Material was mannitol salt agar (MSA) as label material, *tryptone soya agar* (TSA) as inoculant medium and *Staphylococcus aureus* isolate at 3.10^5-

ISBN : 978-1-4673-7404-0

3.10^8 concentration. Isolate made by dilution method base on McFarland 1 standard.

2.2. Method

2.2.1. *Phenol red* label producing

Label was produced by dissolving 27.75 g mannitol salt agar into 250 mL aquadest, then it was heated at 50°C until 90°C. Then it was sterilizated at 121°C for 15 minutes, cooled and formed 2 cm × 3 cm size. There were two different treatment of the label i.e. packed and unpacked. Packed label was done by inserted the pieces of label into LDPE (*low density polyethylene*) plastic and sealed. Before it is used, label was be sterilized by UV for 15 minutes to get phenol label indicator free from contamination. Packed and unpacked label were then ready to be tested further.

2.2.2. *Phenol red* label testing

Phenol red label was attached inside the petri dish lid. Each petri dish has *staphylococcus aureus* by various concentration.

The distance between label and inoculants was ± 2 cm. Petri dish was storage at room temperature for 2 days, and the color change of the label and *Staphylococcus aureus* growth were observed. Dilution control was done by streak method on *phenol red* label. Control was conducted to observe the effect of color change label due to *staphylococcus aureus* contaminated.

2.2.3. Color label measuring

Measuring of color was done by color analyzer RGB 1002. Sensors was placed on the label surface and the measuring was done 3 replicates. The number that appears on the screen was recorded as result of measurement.

2.2.4.*Staphylococcus aureus* number determination

Staphylococcus aureus grow in TSA was white round and then it was measured.

3.Result and discussion

Below was the result of *phenol red* label testing. It can be seen that the color of the label was gradually changing (Table 1. and Tabel 2. for unpacked label, Table 3. and Table 4. for packed label).

Tabel 1. Color change of label unpacked to amount *staphylococcus aureus* growth

	colony	0 hour	colony	3 hours	colony	7 hours	colony	11 hours	colony	15 hours	colony	31 hours
MSA5 control	0		0		171		532		TBUD		TBUD	
L5	0		40		53		160		302		TBUD	
MSA6 control	0		0		0		113		258		1068	
L6	0		48		75		108		320		452	
MSA7 control	0		0		0		132		201		592	
L7	0		15		18		63		189		304	
MSA8 Control	0		0		0		4		173		372	
L8	0		0		8		12		98		106	

note : L (label), 5 (dilution of 10^5), 6 (dilution of 10^6), 7 (dilution of 10^7), 8 (dilution of 10^8), TBUD (can not calculated)

Based on result that color label change from red to yellow. The color changing was shown at label in *staphylococcus aureus* from 302 to more 592. The value of color changing was 30 (R), 94 (G) and 64 (B) to 76(R), 70 (G) and 52(B) and clearly read from Table 2.

Tabel 2. The R-G-B of label color for *staphylococcus aureus* growth

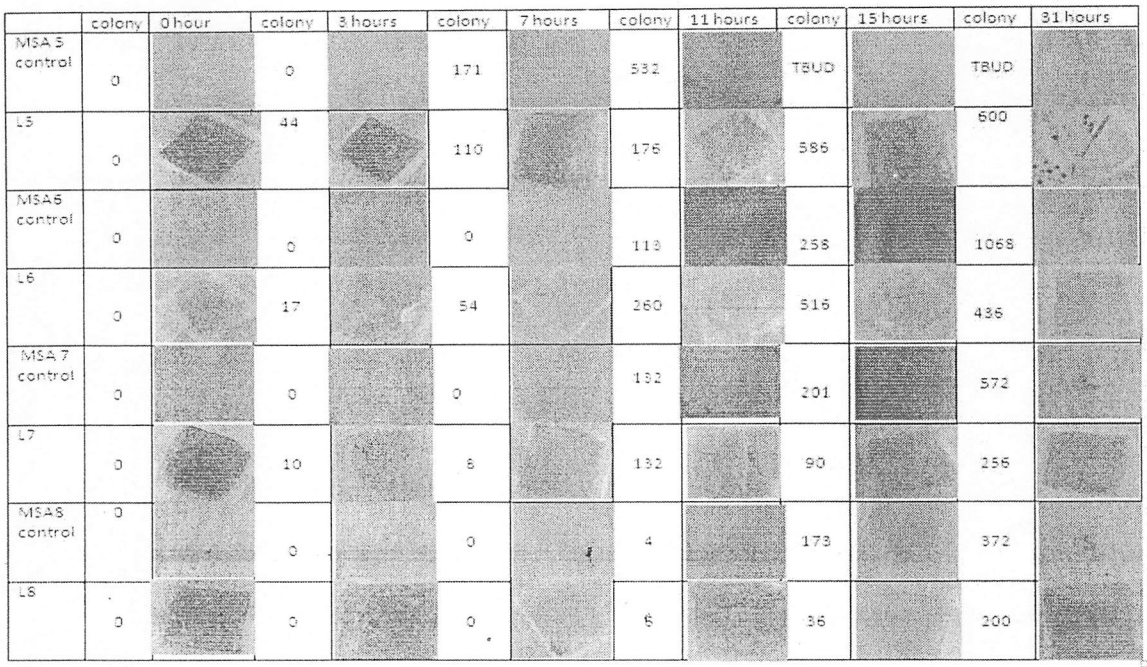
Color of sample	0 hour			3 hours			7 hours			11 hours			15 hours			31 hours		
to hpur	R	G	B	R	G	B	R	G	B	R	G	B	R	G	B	R	G	B
MSA 5 control	041	032	034	047	037	036	060	054	042	044	035	033	044	040	034	064	060	044
L5	035	031	030	049	039	036	062	052	046	046	040	035	043	039	030	055	056	042
MSA 6 control	041	031	030	047	035	034	052	043	035	041	032	030	038	032	030	045	043	034

ISBN : 978-1-4673-7404-0

L6	036	029	028	053	042	041	054	041	037	049	040	037	083	070	059	067	060	037
MSA 7 control	040	030	030	045	032	030	055	044	038	043	031	030	038	030	029	056	053	036
L7	040	028	028	053	042	040	057	042	041	058	047	044	051	039	037	076	070	052
MSA 8 control	040	031	030	051	038	036	058	040	039	050	040	036	044	036	034	060	055	039
L8	037	029	028	053	040	036	056	042	036	054	045	042	056	047	044	066	046	044

note : L (label), 5 (dilution of 10^5), 6 (dilution of 10^6), 7 (dilution of 10^7), 8 (dilution of 10^8)

Tabel 3. Color change of packed label to *staphylococcus aureus* growth



note : L (label), 5 (dilution of 10^5), 6 (dilution of 10^6), 7 (dilution of 10^7), 8 (dilution of 10^8), TBUD (can not calculated)

On label packed, color change start from colony 516-600. The color change 39(R), 26 (G), and 27(B) to 92(R), 76(G) on 64 (B). the data on the Tabel 4.

Tabel 4. The value of packed label during *staphylococcus aureus* growth

Warna sampel	0 hour			3 hours			7 hours			11 hours			15 hours			31 hours		
per Jam	R	G	B	R	G	B	R	G	B	R	G	B	R	G	B	R	G	B
MSA 5 control	041	032	034	047	037	036	060	054	042	044	035	033	044	040	034	064	060	044
L5	043	037	036	091	061	052	086	062	054	068	052	048	049	042	034	092	076	064
MSA 6 control	041	031	030	047	035	034	052	043	035	041	032	030	038	032	030	045	043	034
L6	084	068	058	107	084	069	087	068	058	085	072	064	047	038	034	100	081	071
MSA 7 control	040	030	030	045	032	030	055	044	038	043	031	030	038	030	029	056	053	036
L7	056	040	038	082	049	044	080	047	043	059	045	043	054	040	038	097	073	070
MSA 8 control	040	031	030	051	038	036	058	040	039	050	040	036	044	036	034	060	055	039
L8	045	042	040	180	134	108	142	108	087	056	046	043	052	044	040	085	060	056

note : L (label), 5 (dilution of 10^5), 6 (dilution of 10^6), 7 (dilution of 10^7), 8 (dilution of 10^8)

RGB is an abbreviation for Red-Green-Blue. RGB is a base color for color combination (Saini dan Chan 2013, Binnar *et al* 2014). The value of combination for red and green produce yellow (Nishad dan Chezian 2013). The result show that the increase in red value (R) and green (G) occurring at 31 hours. The color change to yellow due to reaction between *phenol red* and metabolite produced by *staphylococcus aureus*. *Phenol red* is one of indicator color, it usually used to quantitative analysis. *Phenol red* has red color at alkali (pH 8.0) and yellow at acid (pH 6.6). The color will change, if the condition change to acid or alkali. The color change mechanism of *phenol red* label are by volatile and mannitol fermentation.

The volatile was produced by *Staphylococcus aureus* on TSA. TSA (*tryptone soya agar*) is a general medium which contain casein pepton and soya peptone that carbon, nitrogen, vitamins and minerals source to *staphylococcus aureus* growth. Casein pepton contains high tryptophan, while soya pepton contains polypeptide, dipeptide and others amino acid (Bahri *et al* 2009). Casein and amino acid was breakdown by *staphylococcus aureus* to acetic acid volatile,

dimethyl sulfide and methantiol (Carbonero *et al* 2012, Filipiak *et al* 2012). Volatile compounds binding *phenol red* molecule on label so it changes character of *phenol red* to yellow. Ability of label to detect *staphylococcus aureus* affected by amount of *staphylococcus aureus* growth in media.

Mannitol fermentation happen, when *Staphylococcus aureus* contaminate label. *Staphylococcus aureus* grow in label, it fermented mannitol to acid in label. Acid changed pH label, then pH change color of *phenol red.*

Label unpacked has detection ability from s.*aureus* at 302, while label packed at 516. It was caused by the barrier between volatile compounds or bacteria and label. Label packed use LDPE (*low density poly ethylene*) as its packaging. Packaging use in label to prevent contamination for product due to label. Pore size of LDPE about 1.4 μm (Wendorf *et al* 1999), while size of volatile gas about 0.1-1nm and *Staphylococcus aureus* 1 μm (1000 nm). It causes plastic used can be penetrated by volatile gas and *Staphylococcus aureus*.

4. Conclusion

MSA (mannitol salt agar) is one of selective medium to microbe identification, it contains *phenol red* can used as label indicator. The color change label mechanism by volatile and acid from mannitol fermentation. Volatile and acid react with *phenol red* in MSA. Using LDPE as label packed can be used to detection *staphylococcus aureus*. The application, label can applicated to *staphylococcus aureus* easy contamination product by.

5. Suggestion

The weakness of label is label compositon have not been halal or not halal for muslim to application in food, so it needs new halal formulation which can work base on MSA (mannitol salt agar) work principle.

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