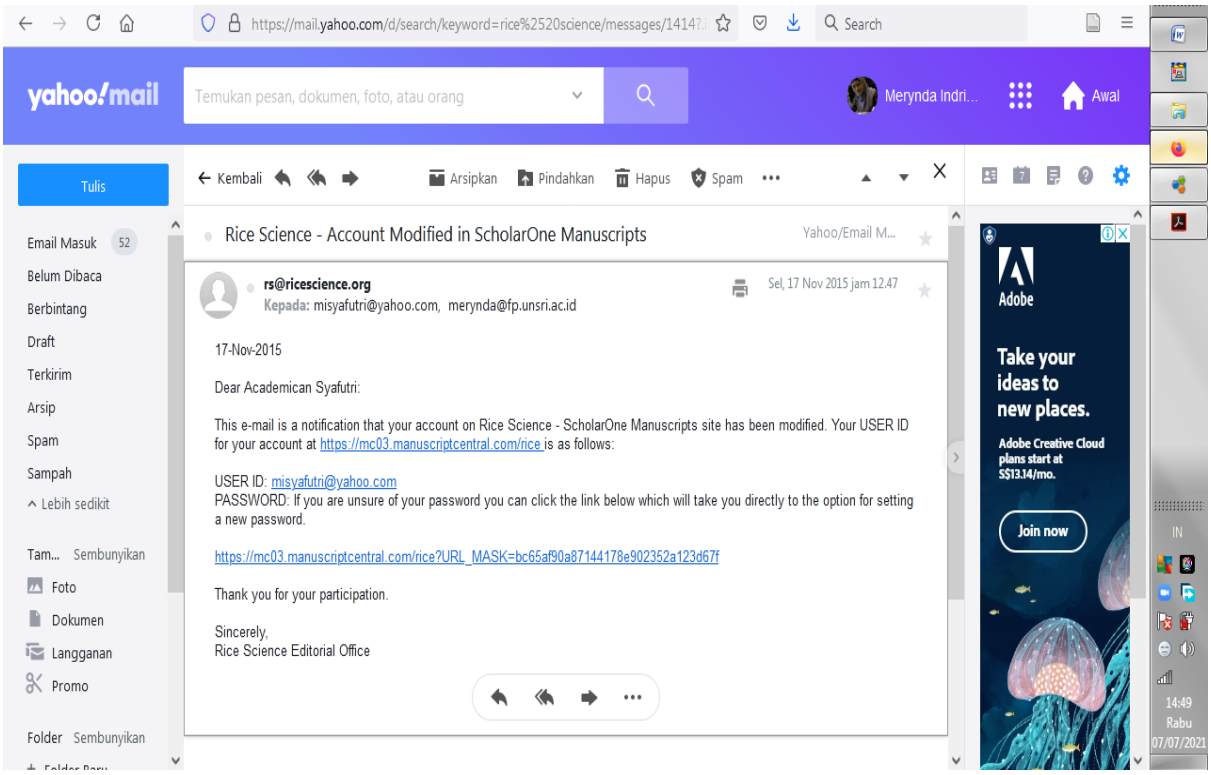
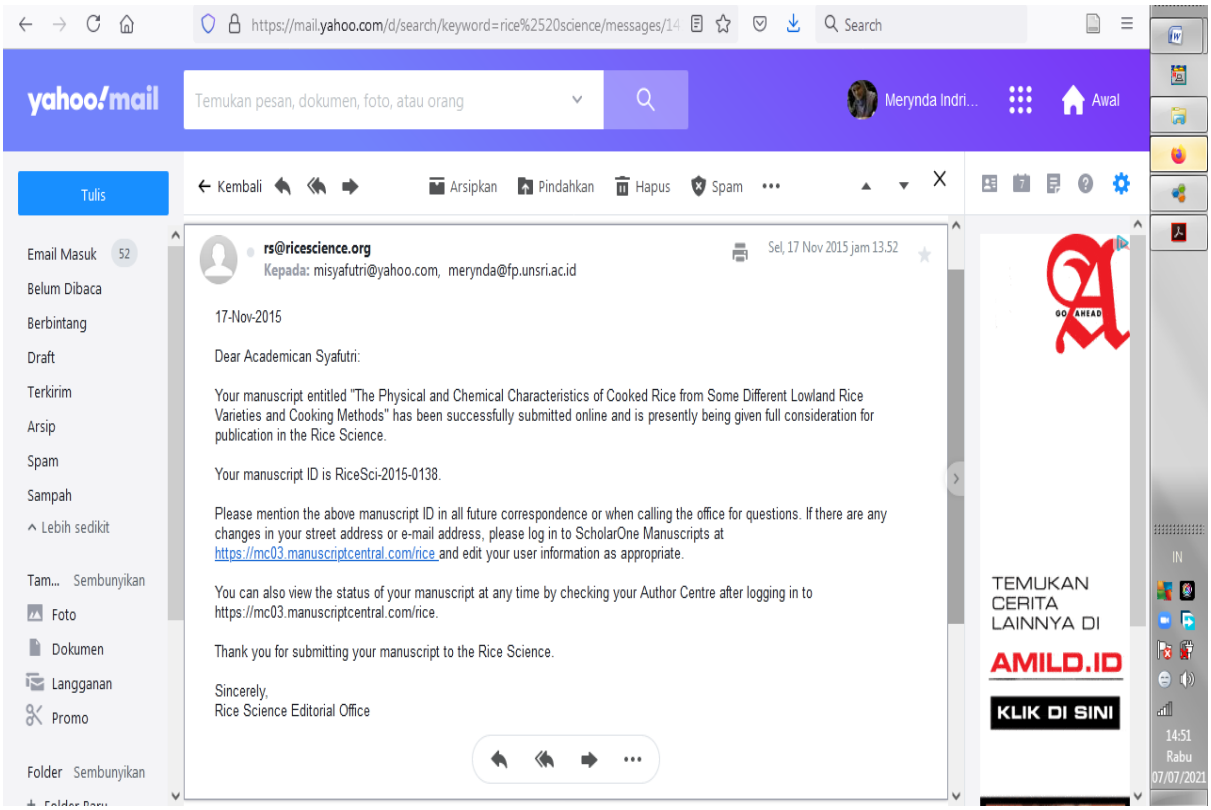
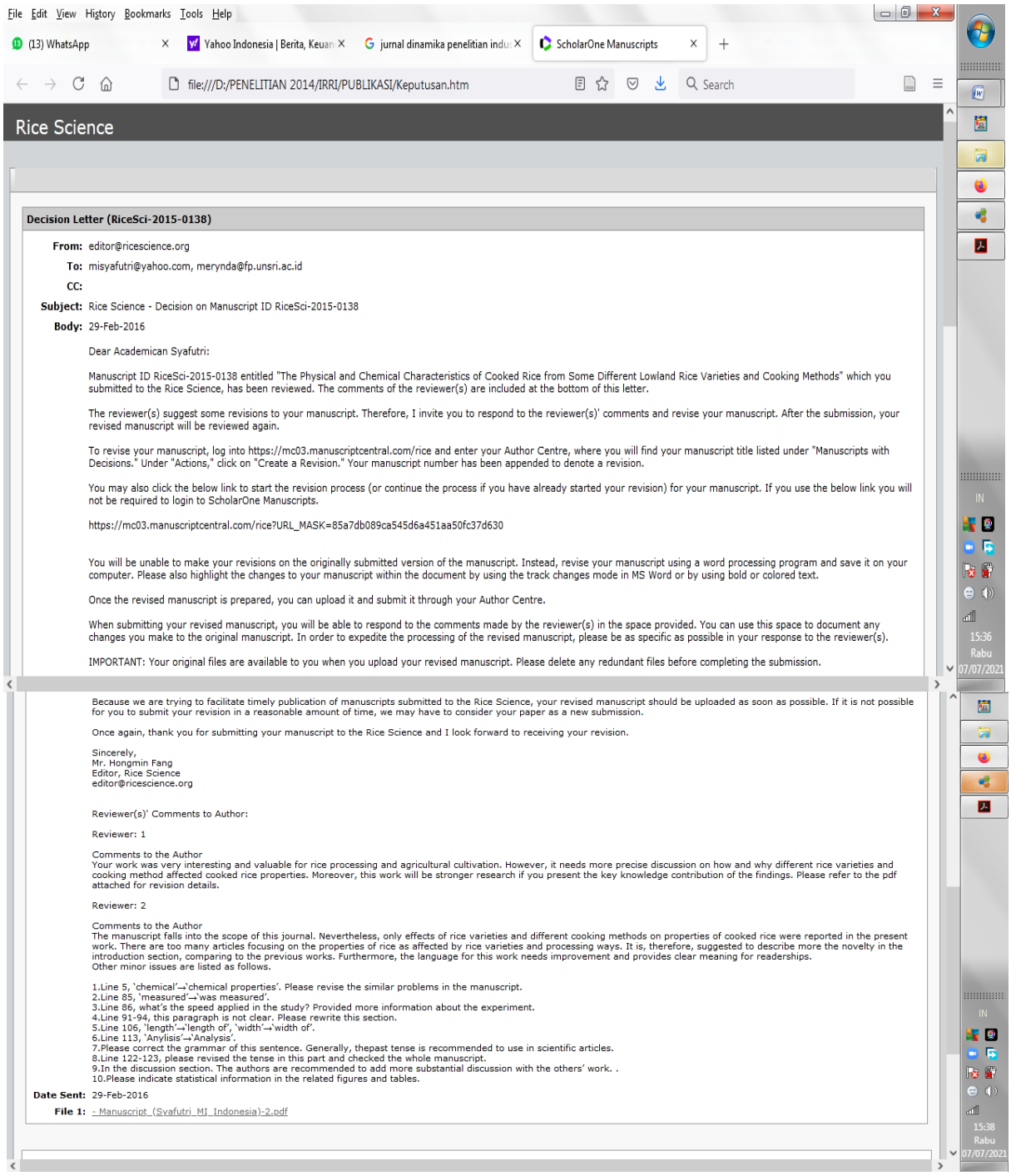
Dokumen Bukti Korespondensi untuk karya penelitian dengan judul artikel : **Effects of Varieties and Cooking Methods on Physical and Chemical Characteristics of Cooked Rice**

Penulis : **Merynda Indriyani Syafutri**, Filli Pratama, Friska Syaiful, Achmad Faizal, Nama Jurnal : Rice Science, Penerbit : Elsevier B.V., Volume Jurnal : 23, Nomor Jurnal : 5, Tahun Terbit Jurnal : September 2016, Halaman : 282-286, ISSN : 1672-6308.

URL Artikel Jurnal :
https://www.sciencedirect.com/science/article/pii/S1672630816300361?via%3Dihub


yahoo!mail
Temukan pesan, dokumen, foto, atau orang
Merynda Indri...
Awal
Tulis
Email Masuk 52
Belum Dibaca
Berbintang
Draft
Terkirim
Arsip
Spam
Sampah
Lebih sedikit
Tam... Sembunyikan
Foto
Dokumen
Langganan
Promo
Folder Sembunyikan
Kembali
Arsipkan
Pindahkan
Hapus
Spam
Rice Science - Account Modified in ScholarOne Manuscripts
Yahoo/Email M...
rs@ricescience.org
Kepada: misyafutri@yahoo.com, merynda@fp.unsri.ac.id
Sel, 17 Nov 2015 jam 12.47
17-Nov-2015
Dear Academican Syafutri:
This e-mail is a notification that your account on Rice Science - ScholarOne Manuscripts site has been modified. Your USER ID for your account at https://mc03.manuscriptcentral.com/rice is as follows:
USER ID: misyafutri@yahoo.com
PASSWORD: If you are unsure of your password you can click the link below which will take you directly to the option for setting a new password.
https://mc03.manuscriptcentral.com/rice?URL_MASK=bc65af90a87144178e902352a123d67f
Thank you for your participation.
Sincerely,
Rice Science Editorial Office
Adobe
Take your ideas to new places.
Adobe Creative Cloud plans start at S$13.14/mo.
Join now
14:49
Rabu
07/07/2021


yahoo!mail
Temukan pesan, dokumen, foto, atau orang
Merynda Indri...
Awal
Tulis
Email Masuk 52
Belum Dibaca
Berbintang
Draft
Terkirim
Arsip
Spam
Sampah
Lebih sedikit
Tam... Sembunyikan
Foto
Dokumen
Langganan
Promo
Folder Sembunyikan
Kembali
Arsipkan
Pindahkan
Hapus
Spam
rs@ricescience.org
Kepada: misyafutri@yahoo.com, merynda@fp.unsri.ac.id
Sel, 17 Nov 2015 jam 13.52
17-Nov-2015
Dear Academican Syafutri:
Your manuscript entitled "The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods" has been successfully submitted online and is presently being given full consideration for publication in the Rice Science.
Your manuscript ID is RiceSci-2015-0138.
Please mention the above manuscript ID in all future correspondence or when calling the office for questions. If there are any changes in your street address or e-mail address, please log in to ScholarOne Manuscripts at https://mc03.manuscriptcentral.com/rice and edit your user information as appropriate.
You can also view the status of your manuscript at any time by checking your Author Centre after logging in to https://mc03.manuscriptcentral.com/rice.
Thank you for submitting your manuscript to the Rice Science.
Sincerely,
Rice Science Editorial Office
TEMUKAN CERITA LAINNYA DI
AMILD.ID
KLIK DI SINI
14:51
Rabu
07/07/2021



File Edit View History Bookmarks Tools Help

(13) WhatsApp | Yahoo Indonesia | Berita, Keuan | jurnal dinamika penelitian indu | ScholarOne Manuscripts

file:///D:/PENELITIAN 2014/IRRI/PUBLIKASI/Keputusan.htm

Search

Rice Science

Decision Letter (RiceSci-2015-0138)

From: editor@ricescience.org

To: misyafutri@yahoo.com, merynda@fp.unsri.ac.id

CC:

Subject: Rice Science - Decision on Manuscript ID RiceSci-2015-0138

Body: 29-Feb-2016

Dear Academican Syafutri:

Manuscript ID RiceSci-2015-0138 entitled "The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods" which you submitted to the Rice Science, has been reviewed. The comments of the reviewer(s) are included at the bottom of this letter.

The reviewer(s) suggest some revisions to your manuscript. Therefore, I invite you to respond to the reviewer(s)' comments and revise your manuscript. After the submission, your revised manuscript will be reviewed again.

To revise your manuscript, log into https://mc03.manuscriptcentral.com/rice and enter your Author Centre, where you will find your manuscript title listed under "Manuscripts with Decisions." Under "Actions," click on "Create a Revision." Your manuscript number has been appended to denote a revision.

You may also click the below link to start the revision process (or continue the process if you have already started your revision) for your manuscript. If you use the below link you will not be required to login to ScholarOne Manuscripts.

https://mc03.manuscriptcentral.com/rice?URL_MASK=85a7db089ca545d6a451aa50fc37d630

You will be unable to make your revisions on the originally submitted version of the manuscript. Instead, revise your manuscript using a word processing program and save it on your computer. Please also highlight the changes to your manuscript within the document by using the track changes mode in MS Word or by using bold or colored text.

Once the revised manuscript is prepared, you can upload it and submit it through your Author Centre.

When submitting your revised manuscript, you will be able to respond to the comments made by the reviewer(s) in the space provided. You can use this space to document any changes you make to the original manuscript. In order to expedite the processing of the revised manuscript, please be as specific as possible in your response to the reviewer(s).

IMPORTANT: Your original files are available to you when you upload your revised manuscript. Please delete any redundant files before completing the submission.

Because we are trying to facilitate timely publication of manuscripts submitted to the Rice Science, your revised manuscript should be uploaded as soon as possible. If it is not possible for you to submit your revision in a reasonable amount of time, we may have to consider your paper as a new submission.

Once again, thank you for submitting your manuscript to the Rice Science and I look forward to receiving your revision.

Sincerely,
Mr. Hongmin Fang
Editor, Rice Science
editor@ricescience.org

Reviewer(s)' Comments to Author:

Reviewer: 1

Comments to the Author
Your work was very interesting and valuable for rice processing and agricultural cultivation. However, it needs more precise discussion on how and why different rice varieties and cooking method affected cooked rice properties. Moreover, this work will be stronger research if you present the key knowledge contribution of the findings. Please refer to the pdf attached for revision details.

Reviewer: 2

Comments to the Author
The manuscript falls into the scope of this journal. Nevertheless, only effects of rice varieties and different cooking methods on properties of cooked rice were reported in the present work. There are too many articles focusing on the properties of rice as affected by rice varieties and processing ways. It is, therefore, suggested to describe more the novelty in the introduction section, comparing to the previous works. Furthermore, the language for this work needs improvement and provides clear meaning for readerships.
Other minor issues are listed as follows.

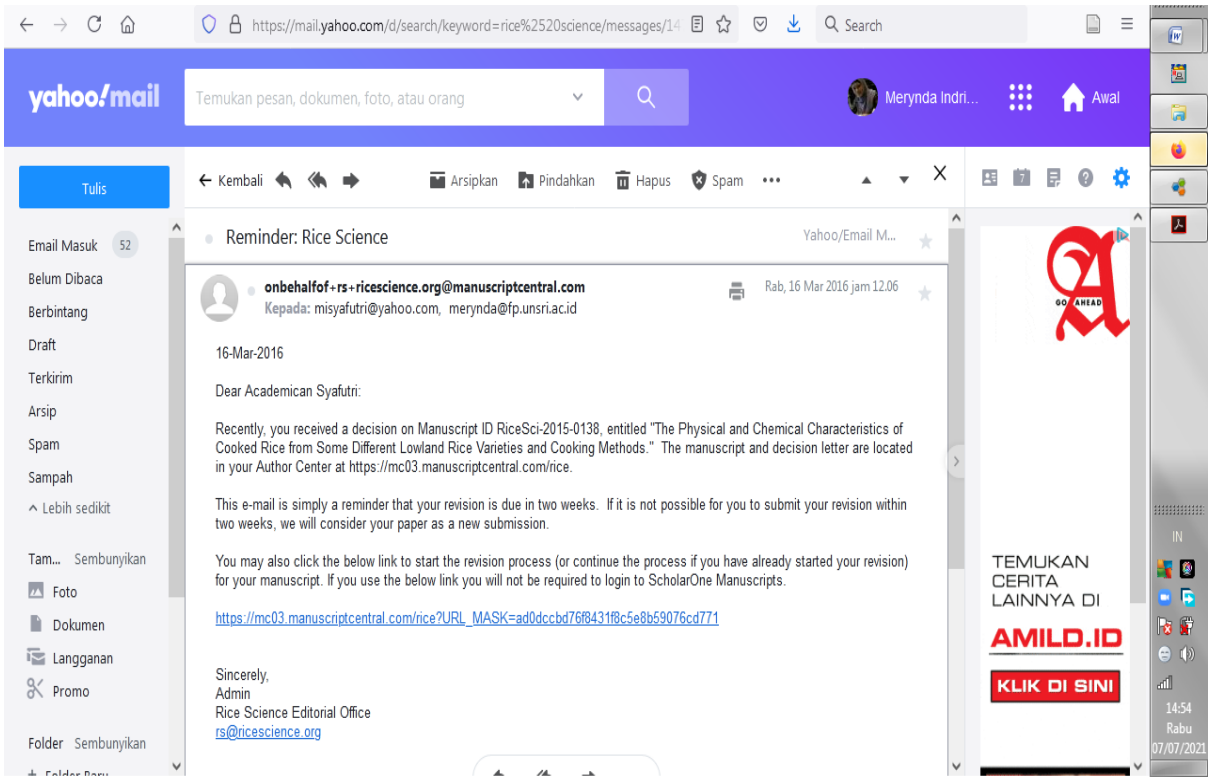
1.Line 5, 'chemical'→'chemical properties'. Please revise the similar problems in the manuscript.
2.Line 85, 'measured'→'was measured'.
3.Line 86, what's the speed applied in the study? Provided more information about the experiment.
4.Line 91-94, this paragraph is not clear. Please rewrite this section.
5.Line 106, 'length'→'length of', 'width'→'width of'.
6.Line 113, 'Anylisis'→'Analysis'.
7.Please correct the grammar of this sentence. Generally, thepast tense is recommended to use in scientific articles.
8.Line 122-123, please revised the tense in this part and checked the whole manuscript.
9.In the discussion section. The authors are recommended to add more substantial discussion with the others' work. .
10.Please indicate statistical information in the related figures and tables.

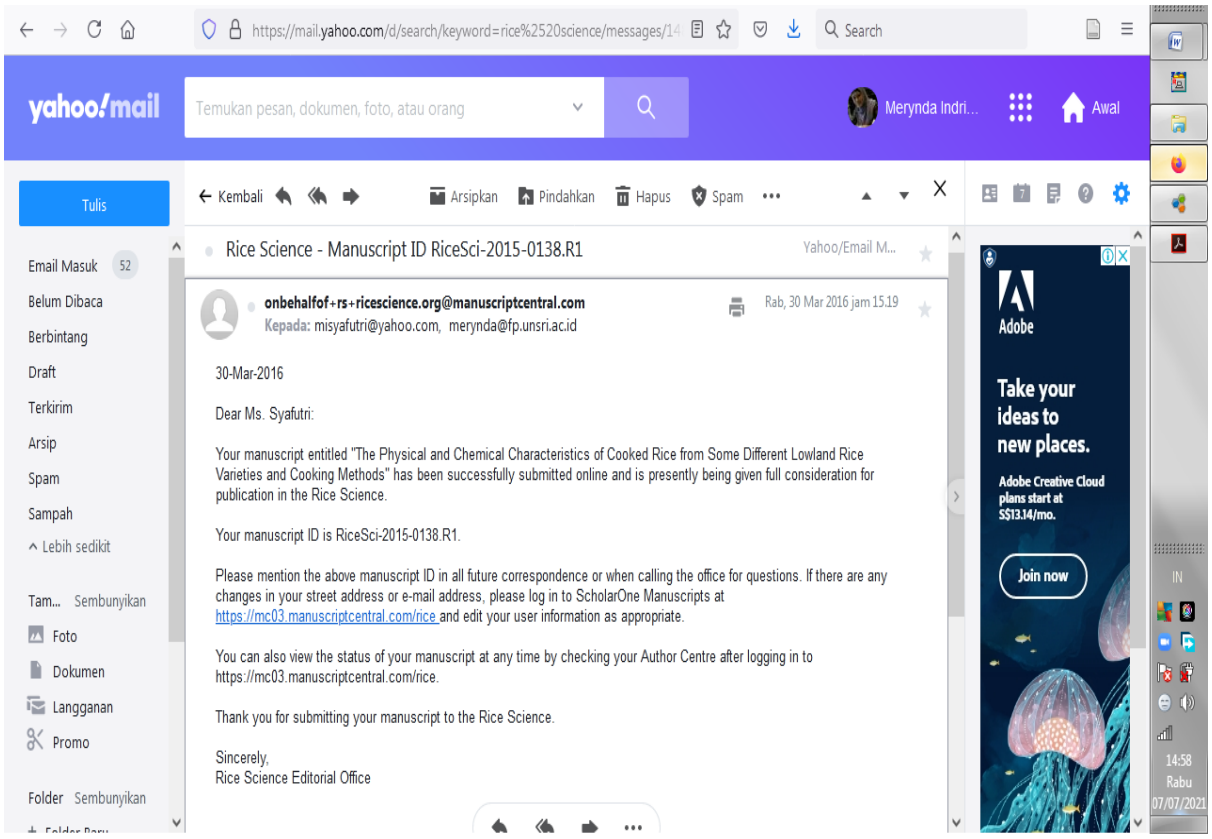
Date Sent: 29-Feb-2016

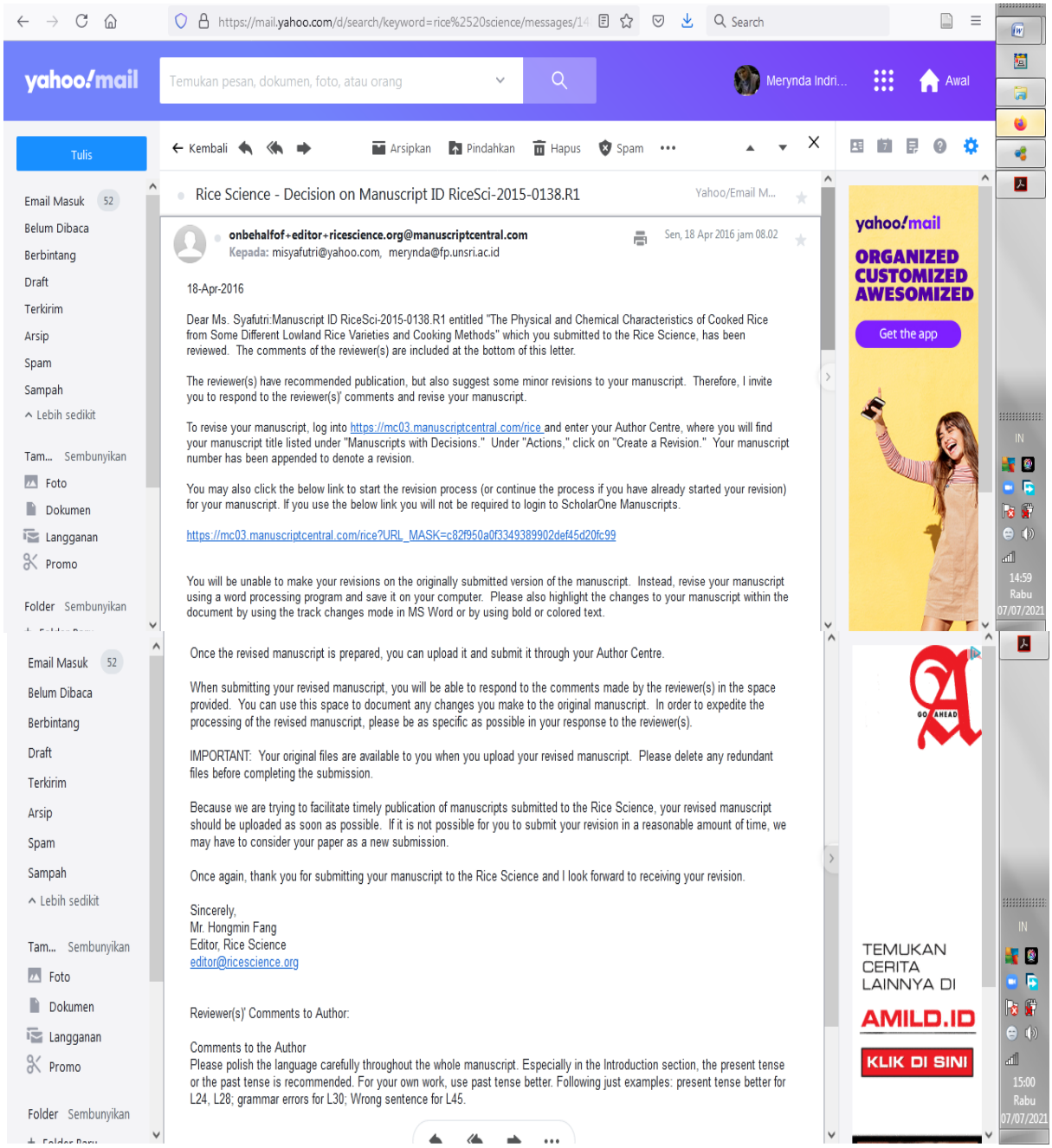
File 1: - Manuscript (Syafutri_MI_Indonesia)-2.pdf

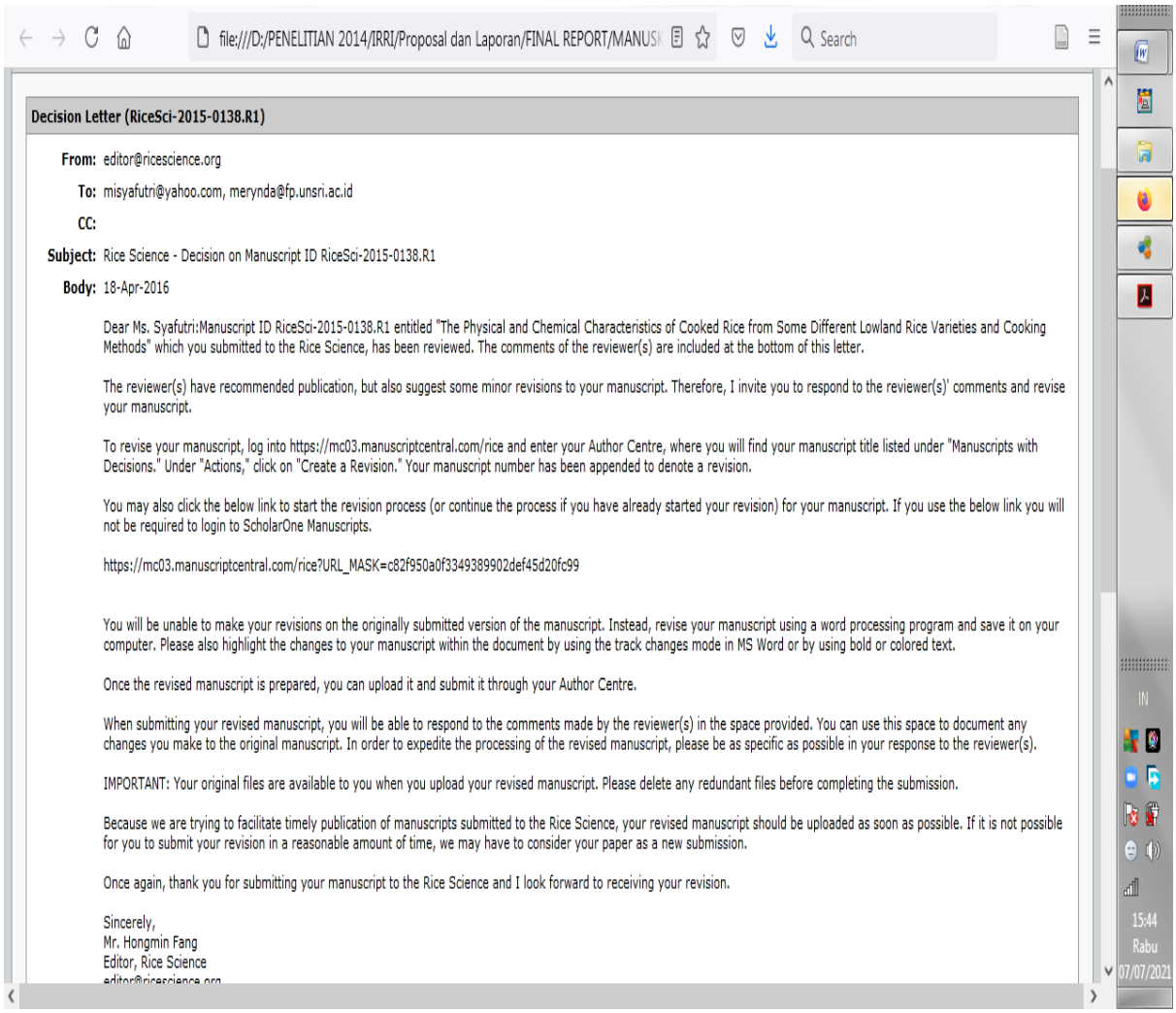
15:36 Rabu 07/07/2021

15:38 Rabu 07/07/2021


yahoo!mail
Temukan pesan, dokumen, foto, atau orang
Merynda Indri...
Awal
Tulis
Email Masuk 52
Belum Dibaca
Berbintang
Draft
Terkirim
Arsip
Spam
Sampah
Lebih sedikit
Tam... Sembunyikan
Foto
Dokumen
Langganan
Promo
Folder Sembunyikan
Kembali
Arsipkan
Pindahkan
Hapus
Spam
Reminder: Rice Science
Yahoo/Email M...
onbehalfof+rs+ricescience.org@manuscriptcentral.com
Kepada: misyafutri@yahoo.com, merynda@fp.unsri.ac.id
Rab, 16 Mar 2016 jam 12.06
16-Mar-2016
Dear Academican Syafutri:
Recently, you received a decision on Manuscript ID RiceSci-2015-0138, entitled "The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods." The manuscript and decision letter are located in your Author Center at https://mc03.manuscriptcentral.com/rice.
This e-mail is simply a reminder that your revision is due in two weeks. If it is not possible for you to submit your revision within two weeks, we will consider your paper as a new submission.
You may also click the below link to start the revision process (or continue the process if you have already started your revision) for your manuscript. If you use the below link you will not be required to login to ScholarOne Manuscripts.
https://mc03.manuscriptcentral.com/rice?URL_MASK=ad0dccbd76f8431f8c5e8b59076cd771
Sincerely,
Admin
Rice Science Editorial Office
rs@ricescience.org
TEMUKAN CERITA LAINNYA DI
AMILD.ID
KLIK DI SINI
14:54
Rabu
07/07/2021


yahoo!mail
Temukan pesan, dokumen, foto, atau orang
Merynda Indri...
Awal
Tulis
Email Masuk 52
Belum Dibaca
Berbintang
Draft
Terkirim
Arsip
Spam
Sampah
Lebih sedikit
Tam... Sembunyikan
Foto
Dokumen
Langganan
Promo
Folder Sembunyikan
Kembali
Arsipkan
Pindahkan
Hapus
Spam
Rice Science - Manuscript ID RiceSci-2015-0138.R1
Yahoo/Email M...
onbehalfof+rs+ricescience.org@manuscriptcentral.com
Kepada: misyafutri@yahoo.com, merynda@fp.unsri.ac.id
Rab, 30 Mar 2016 jam 15.19
30-Mar-2016
Dear Ms. Syafutri:
Your manuscript entitled "The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods" has been successfully submitted online and is presently being given full consideration for publication in the Rice Science.
Your manuscript ID is RiceSci-2015-0138.R1.
Please mention the above manuscript ID in all future correspondence or when calling the office for questions. If there are any changes in your street address or e-mail address, please log in to ScholarOne Manuscripts at https://mc03.manuscriptcentral.com/rice and edit your user information as appropriate.
You can also view the status of your manuscript at any time by checking your Author Centre after logging in to https://mc03.manuscriptcentral.com/rice.
Thank you for submitting your manuscript to the Rice Science.
Sincerely,
Rice Science Editorial Office
Adobe
Take your ideas to new places.
Adobe Creative Cloud plans start at S$13.14/mo.
Join now
14:58
Rabu
07/07/2021


yahoo!mail
Temukan pesan, dokumen, foto, atau orang
Merynda Indri...
Awal
Tulis
Email Masuk 52
Belum Dibaca
Berbintang
Draft
Terkirim
Arsip
Spam
Sampah
Lebih sedikit
Tam... Sembunyikan
Foto
Dokumen
Langganan
Promo
Folder Sembunyikan
Kembali
Arsipkan
Pindahkan
Hapus
Spam
Rice Science - Decision on Manuscript ID RiceSci-2015-0138.R1
Yahoo/Email M...
onbehalfof+editor+ricescience.org@manuscriptcentral.com
Kepada: misyafutri@yahoo.com, merynda@fp.unsri.ac.id
Sen, 18 Apr 2016 jam 08.02
18-Apr-2016
Dear Ms. Syafutri:Manuscript ID RiceSci-2015-0138.R1 entitled "The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods" which you submitted to the Rice Science, has been reviewed. The comments of the reviewer(s) are included at the bottom of this letter.
The reviewer(s) have recommended publication, but also suggest some minor revisions to your manuscript. Therefore, I invite you to respond to the reviewer(s)' comments and revise your manuscript.
To revise your manuscript, log into https://mc03.manuscriptcentral.com/rice and enter your Author Centre, where you will find your manuscript title listed under "Manuscripts with Decisions." Under "Actions," click on "Create a Revision." Your manuscript number has been appended to denote a revision.
You may also click the below link to start the revision process (or continue the process if you have already started your revision) for your manuscript. If you use the below link you will not be required to login to ScholarOne Manuscripts.
https://mc03.manuscriptcentral.com/rice?URL_MASK=c82f950a0f3349389902def45d20fc99
You will be unable to make your revisions on the originally submitted version of the manuscript. Instead, revise your manuscript using a word processing program and save it on your computer. Please also highlight the changes to your manuscript within the document by using the track changes mode in MS Word or by using bold or colored text.
Once the revised manuscript is prepared, you can upload it and submit it through your Author Centre.
When submitting your revised manuscript, you will be able to respond to the comments made by the reviewer(s) in the space provided. You can use this space to document any changes you make to the original manuscript. In order to expedite the processing of the revised manuscript, please be as specific as possible in your response to the reviewer(s).
IMPORTANT: Your original files are available to you when you upload your revised manuscript. Please delete any redundant files before completing the submission.
Because we are trying to facilitate timely publication of manuscripts submitted to the Rice Science, your revised manuscript should be uploaded as soon as possible. If it is not possible for you to submit your revision in a reasonable amount of time, we may have to consider your paper as a new submission.
Once again, thank you for submitting your manuscript to the Rice Science and I look forward to receiving your revision.
Sincerely,
Mr. Hongmin Fang
Editor, Rice Science
editor@ricescience.org
Reviewer(s)' Comments to Author:
Comments to the Author
Please polish the language carefully throughout the whole manuscript. Especially in the Introduction section, the present tense or the past tense is recommended. For your own work, use past tense better. Following just examples: present tense better for L24, L28; grammar errors for L30; Wrong sentence for L45.
yahoo!mail
ORGANIZED
CUSTOMIZED
AWESOMIZED
Get the app
TEMUKAN
CERITA
LAINNYA DI
AMILD.ID
KLIK DI SINI
14:59
Rabu
07/07/2021
15:00
Rabu
07/07/2021



Decision Letter (RiceSci-2015-0138.R1)

From: editor@ricescience.org

To: misyafutri@yahoo.com, merynda@fp.unsri.ac.id

CC:

Subject: Rice Science - Decision on Manuscript ID RiceSci-2015-0138.R1

Body: 18-Apr-2016

Dear Ms. Syafutri:Manuscript ID RiceSci-2015-0138.R1 entitled "The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods" which you submitted to the Rice Science, has been reviewed. The comments of the reviewer(s) are included at the bottom of this letter.

The reviewer(s) have recommended publication, but also suggest some minor revisions to your manuscript. Therefore, I invite you to respond to the reviewer(s)' comments and revise your manuscript.

To revise your manuscript, log into https://mc03.manuscriptcentral.com/rice and enter your Author Centre, where you will find your manuscript title listed under "Manuscripts with Decisions." Under "Actions," click on "Create a Revision." Your manuscript number has been appended to denote a revision.

You may also click the below link to start the revision process (or continue the process if you have already started your revision) for your manuscript. If you use the below link you will not be required to login to ScholarOne Manuscripts.

https://mc03.manuscriptcentral.com/rice?URL_MASK=c82f950a0f3349389902def45d20fc99

You will be unable to make your revisions on the originally submitted version of the manuscript. Instead, revise your manuscript using a word processing program and save it on your computer. Please also highlight the changes to your manuscript within the document by using the track changes mode in MS Word or by using bold or colored text.

Once the revised manuscript is prepared, you can upload it and submit it through your Author Centre.

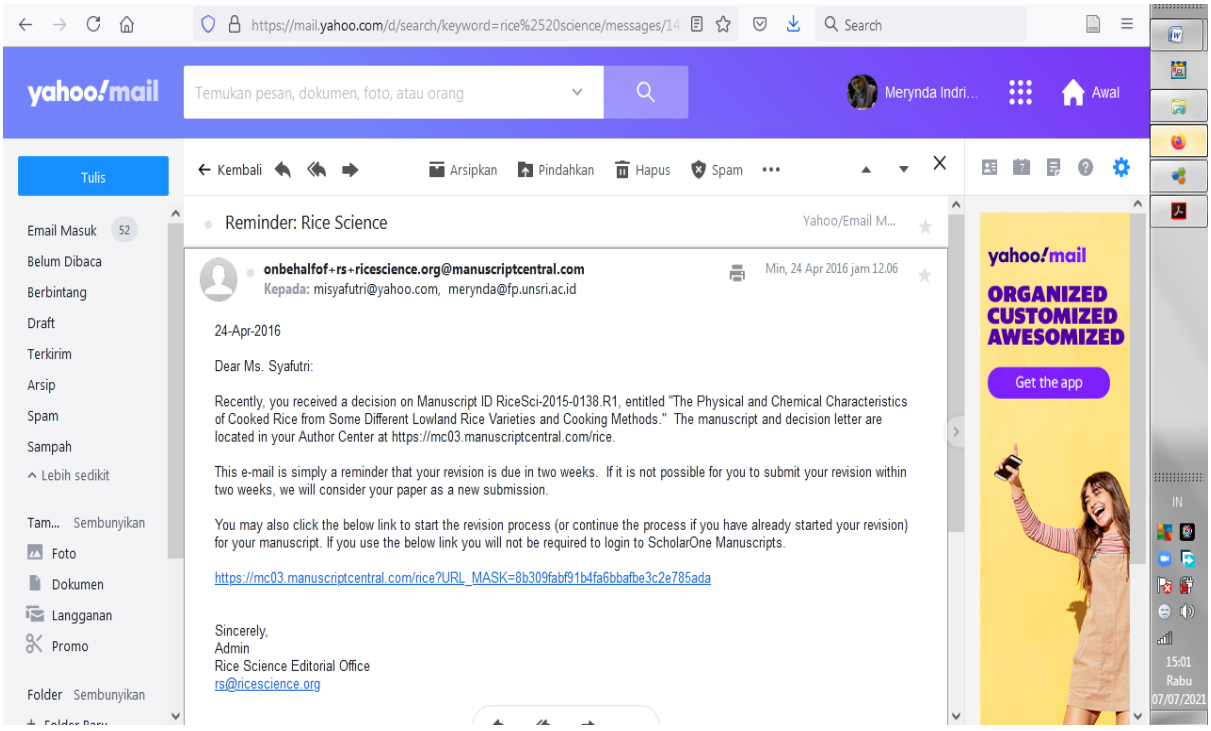
When submitting your revised manuscript, you will be able to respond to the comments made by the reviewer(s) in the space provided. You can use this space to document any changes you make to the original manuscript. In order to expedite the processing of the revised manuscript, please be as specific as possible in your response to the reviewer(s).

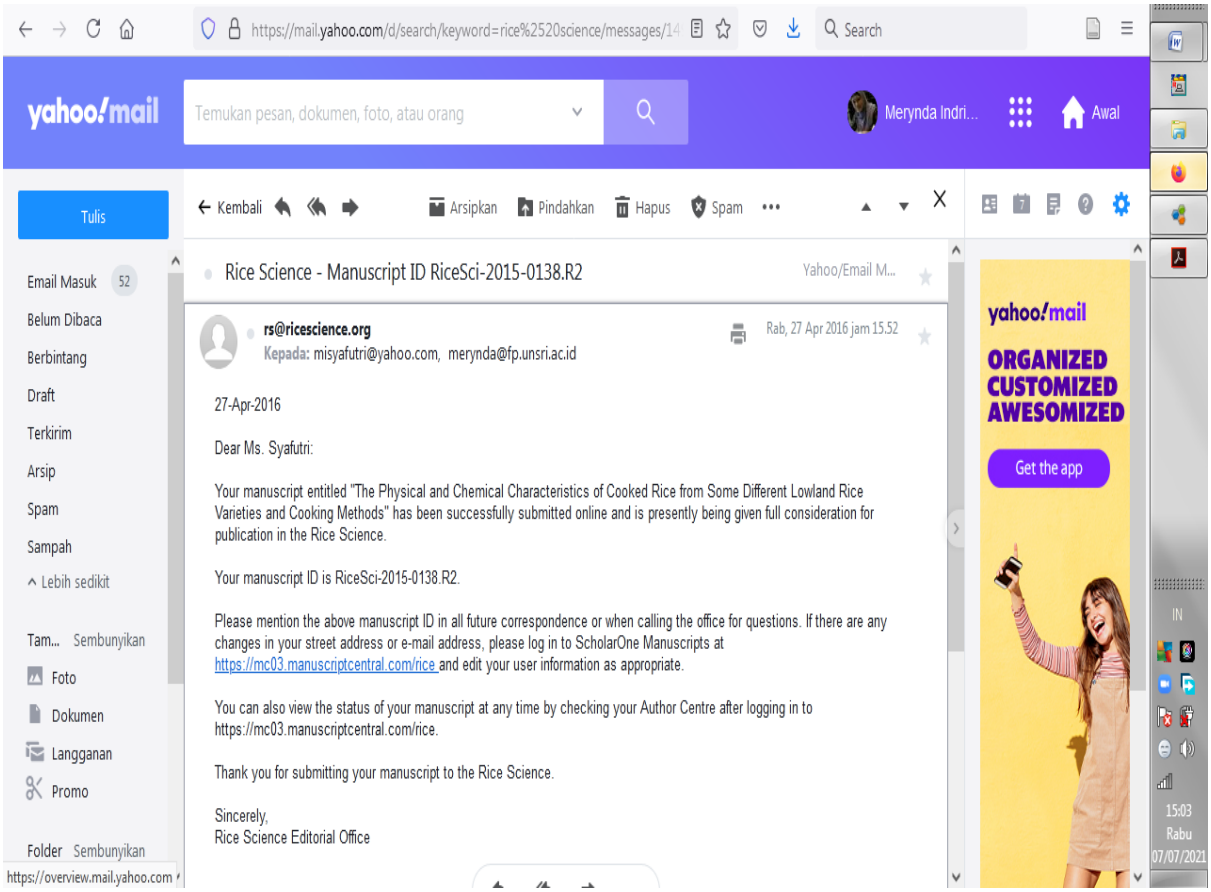
IMPORTANT: Your original files are available to you when you upload your revised manuscript. Please delete any redundant files before completing the submission.

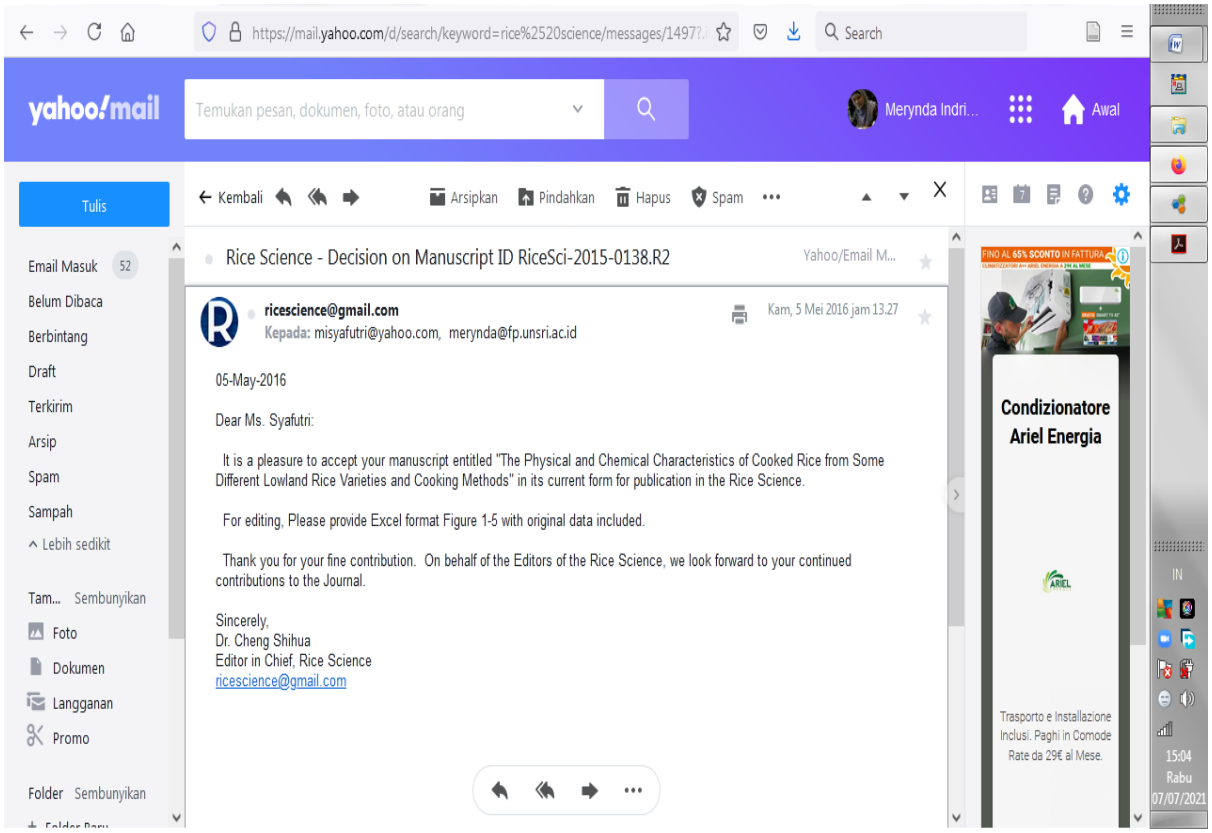
Because we are trying to facilitate timely publication of manuscripts submitted to the Rice Science, your revised manuscript should be uploaded as soon as possible. If it is not possible for you to submit your revision in a reasonable amount of time, we may have to consider your paper as a new submission.

Once again, thank you for submitting your manuscript to the Rice Science and I look forward to receiving your revision.

Sincerely,
Mr. Hongmin Fang
Editor, Rice Science
editor@ricescience.org


yahoo!mail
Temukan pesan, dokumen, foto, atau orang
Merynda Indri...
Awal
Tulis
Kembali
Arsipkan
Pindahkan
Hapus
Spam
Email Masuk 52
Belum Dibaca
Berbintang
Draft
Terkirim
Arsip
Spam
Sampah
Lebih sedikit
Tam... Sembunyikan
Foto
Dokumen
Langganan
Promo
Folder Sembunyikan
Reminder: Rice Science
Yahoo/Email M...
onbehalfof+rs+ricescience.org@manuscriptcentral.com
Kepada: misyafutri@yahoo.com, merynda@fp.unsri.ac.id
Min, 24 Apr 2016 jam 12.06
24-Apr-2016
Dear Ms. Syafutri:
Recently, you received a decision on Manuscript ID RiceSci-2015-0138.R1, entitled "The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods." The manuscript and decision letter are located in your Author Center at https://mc03.manuscriptcentral.com/rice.
This e-mail is simply a reminder that your revision is due in two weeks. If it is not possible for you to submit your revision within two weeks, we will consider your paper as a new submission.
You may also click the below link to start the revision process (or continue the process if you have already started your revision) for your manuscript. If you use the below link you will not be required to login to ScholarOne Manuscripts.
https://mc03.manuscriptcentral.com/rice?URL_MASK=8b309fabf91b4fa6bbafbe3c2e785ada
Sincerely,
Admin
Rice Science Editorial Office
rs@ricescience.org
yahoo!mail
ORGANIZED
CUSTOMIZED
AWESOMIZED
Get the app
IN
15:01
Rabu
07/07/2021


yahoo!mail
Temukan pesan, dokumen, foto, atau orang
Merynda Indri...
Awal
Tulis
Kembali
Arsipkan
Pindahkan
Hapus
Spam
Email Masuk 52
Belum Dibaca
Berbintang
Draft
Terkirim
Arsip
Spam
Sampah
Lebih sedikit
Tam... Sembunyikan
Foto
Dokumen
Langganan
Promo
Folder Sembunyikan
Rice Science - Manuscript ID RiceSci-2015-0138.R2
Yahoo/Email M...
rs@ricescience.org
Kepada: misyafutri@yahoo.com, merynda@fp.unsri.ac.id
Rab, 27 Apr 2016 jam 15.52
27-Apr-2016
Dear Ms. Syafutri:
Your manuscript entitled "The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods" has been successfully submitted online and is presently being given full consideration for publication in the Rice Science.
Your manuscript ID is RiceSci-2015-0138.R2.
Please mention the above manuscript ID in all future correspondence or when calling the office for questions. If there are any changes in your street address or e-mail address, please log in to ScholarOne Manuscripts at https://mc03.manuscriptcentral.com/rice and edit your user information as appropriate.
You can also view the status of your manuscript at any time by checking your Author Centre after logging in to https://mc03.manuscriptcentral.com/rice.
Thank you for submitting your manuscript to the Rice Science.
Sincerely,
Rice Science Editorial Office
yahoo!mail
ORGANIZED
CUSTOMIZED
AWESOMIZED
Get the app
IN
15:03
Rabu
07/07/2021
https://overview.mail.yahoo.com



Rice Science - Decision on Manuscript ID RiceSci-2015-0138.R2

ricescience@gmail.com
Kepada: misyafutri@yahoo.com, merynda@fp.unsri.ac.id
Kam, 5 Mei 2016 jam 13.27

05-May-2016

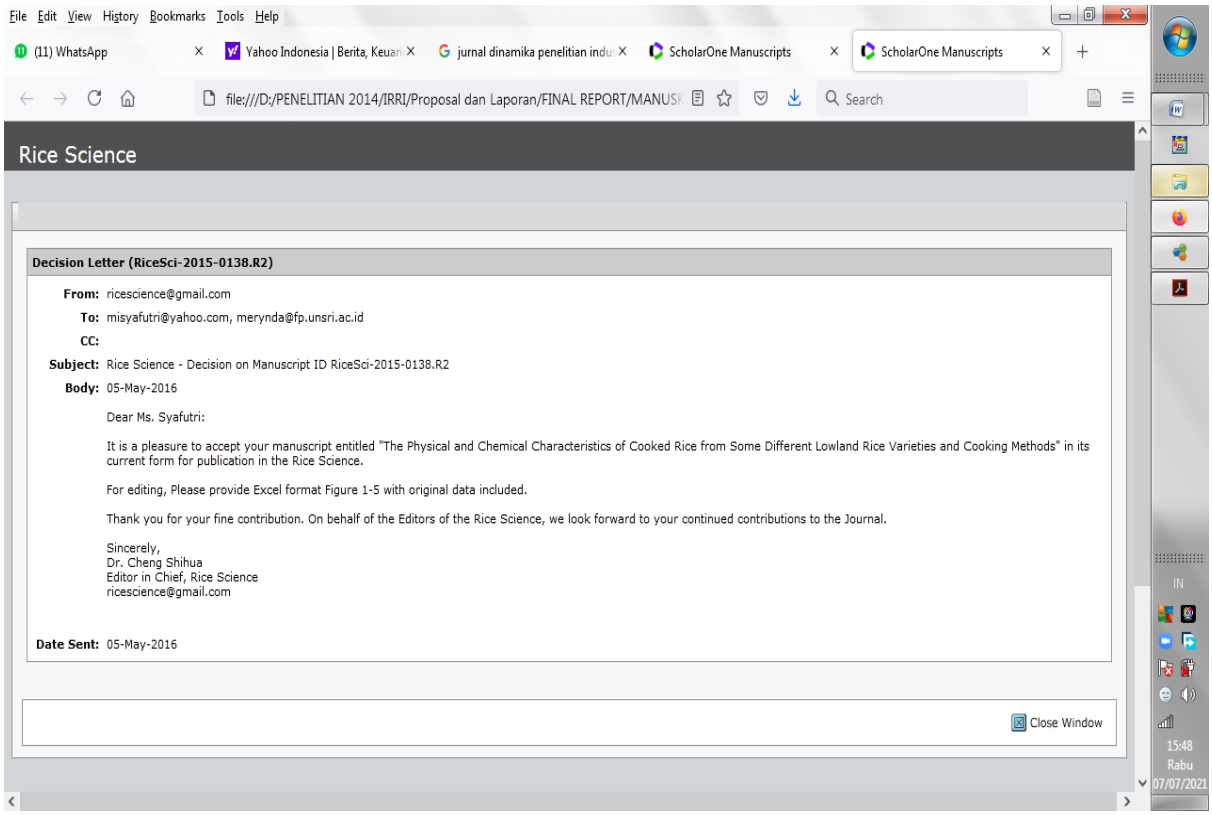
Dear Ms. Syafutri:

It is a pleasure to accept your manuscript entitled "The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods" in its current form for publication in the Rice Science.

For editing, Please provide Excel format Figure 1-5 with original data included.

Thank you for your fine contribution. On behalf of the Editors of the Rice Science, we look forward to your continued contributions to the Journal.

Sincerely,
Dr. Cheng Shihua
Editor in Chief, Rice Science
ricescience@gmail.com



Rice Science

Decision Letter (RiceSci-2015-0138.R2)

From: ricescience@gmail.com
To: misyafutri@yahoo.com, merynda@fp.unsri.ac.id
CC:
Subject: Rice Science - Decision on Manuscript ID RiceSci-2015-0138.R2
Body: 05-May-2016

Dear Ms. Syafutri:

It is a pleasure to accept your manuscript entitled "The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods" in its current form for publication in the Rice Science.

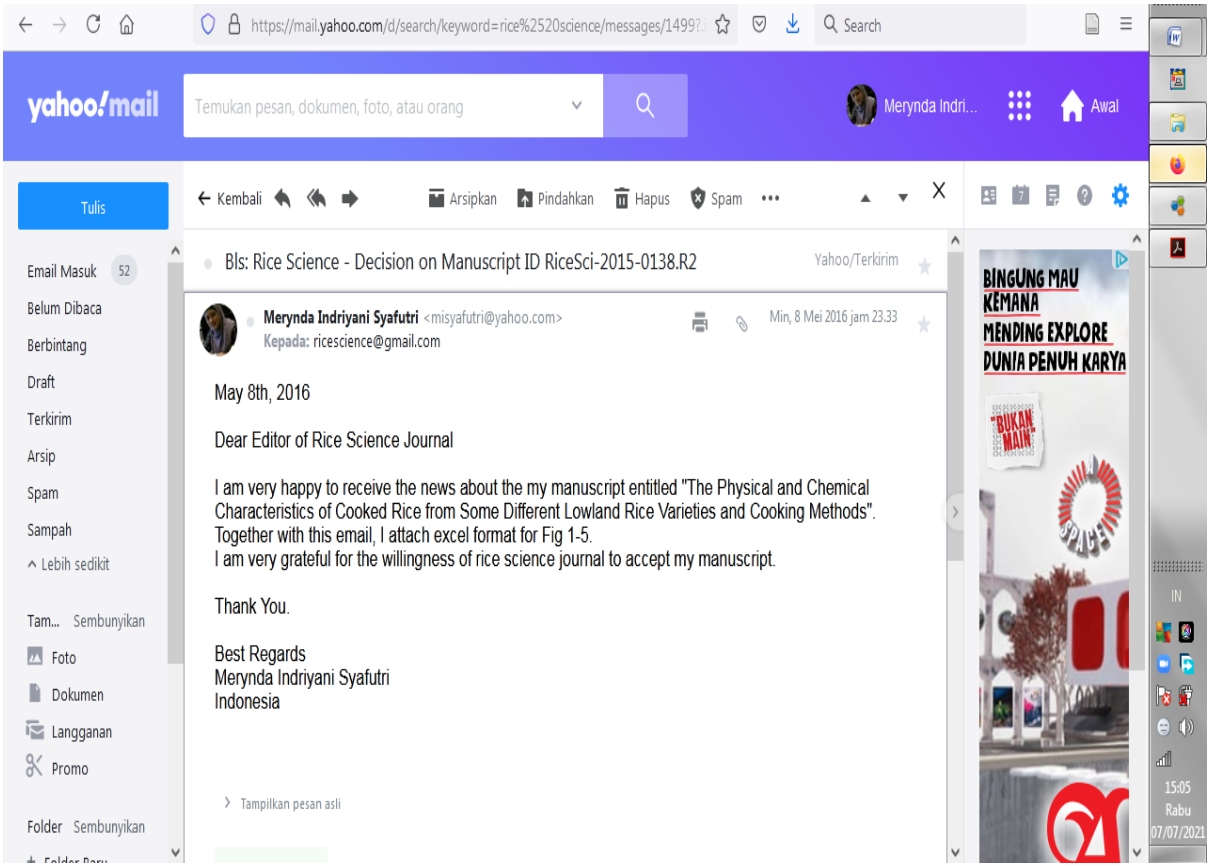
For editing, Please provide Excel format Figure 1-5 with original data included.

Thank you for your fine contribution. On behalf of the Editors of the Rice Science, we look forward to your continued contributions to the Journal.

Sincerely,
Dr. Cheng Shihua
Editor in Chief, Rice Science
ricescience@gmail.com

Date Sent: 05-May-2016

Close Window



yahoo!mail

Temukan pesan, dokumen, foto, atau orang

Merynda Indri...

Awal

Tulis

Email Masuk 52
Belum Dibaca
Berbintang
Draft
Terkirim
Arsip
Spam
Sampah
Lebih sedikit

Tam... Sembunyikan
Foto
Dokumen
Langganan
Promo

Folder Sembunyikan

Kembali | Arsipkan | Pindahkan | Hapus | Spam

Bls: Rice Science - Decision on Manuscript ID RiceSci-2015-0138.R2

Yahoo/Terkirim

Merynda Indriyani Syafutri <misyafutri@yahoo.com>
Kepada: ricescience@gmail.com

Min, 8 Mei 2016 jam 23.33

May 8th, 2016

Dear Editor of Rice Science Journal

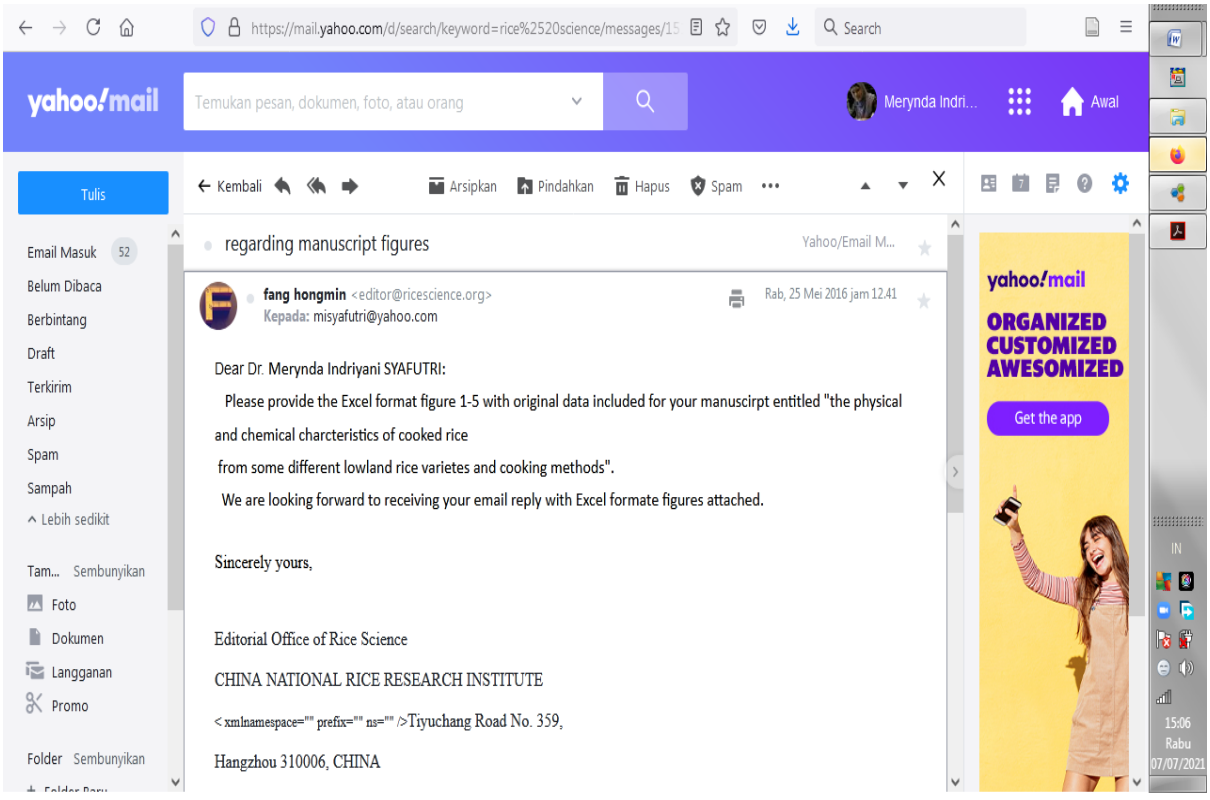
I am very happy to receive the news about the my manuscript entitled "The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods". Together with this email, I attach excel format for Fig 1-5.
I am very grateful for the willingness of rice science journal to accept my manuscript.

Thank You.

Best Regards
Merynda Indriyani Syafutri
Indonesia

Tampilkan pesan asli

IN
15:05
Rabu
07/07/2021



yahoo!mail

Temukan pesan, dokumen, foto, atau orang

Merynda Indri...

Awal

Tulis

Email Masuk 52
Belum Dibaca
Berbintang
Draft
Terkirim
Arsip
Spam
Sampah
Lebih sedikit

Tam... Sembunyikan
Foto
Dokumen
Langganan
Promo

Folder Sembunyikan

Kembali | Arsipkan | Pindahkan | Hapus | Spam

regarding manuscript figures

Yahoo/Email M...

fang hongmin <editor@ricescience.org>
Kepada: misyafutri@yahoo.com

Rab, 25 Mei 2016 jam 12.41

Dear Dr. Merynda Indriyani SYAFUTRI:

Please provide the Excel format figure 1-5 with original data included for your manuscirpt entitled "the physical and chemical charcteristics of cooked rice
from some different lowland rice varietes and cooking methods".
We are looking forward to receiving your email reply with Excel formate figures attached.

Sincerely yours,

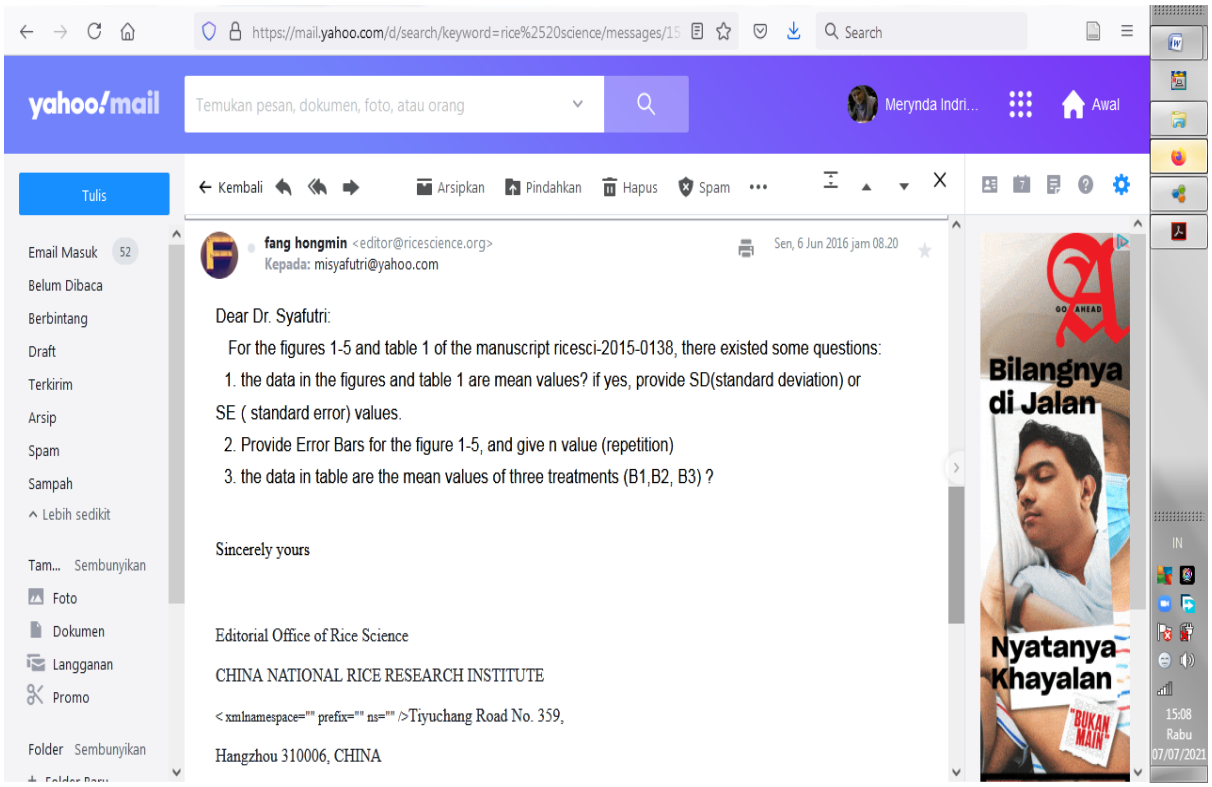
Editorial Office of Rice Science

CHINA NATIONAL RICE RESEARCH INSTITUTE

<xmlnamespace="" prefix="" ns="" />Tiyuchang Road No. 359,

Hangzhou 310006, CHINA

IN
15:06
Rabu
07/07/2021



fang hongmin <editor@ricescience.org>
Kepada: misyafutri@yahoo.com
Sen, 6 Jun 2016 jam 08.20

Dear Dr. Syafutri:

For the figures 1-5 and table 1 of the manuscript ricesci-2015-0138, there existed some questions:

1. the data in the figures and table 1 are mean values? if yes, provide SD(standard deviation) or SE (standard error) values.
2. Provide Error Bars for the figure 1-5, and give n value (repetition)
3. the data in table are the mean values of three treatments (B1,B2, B3) ?

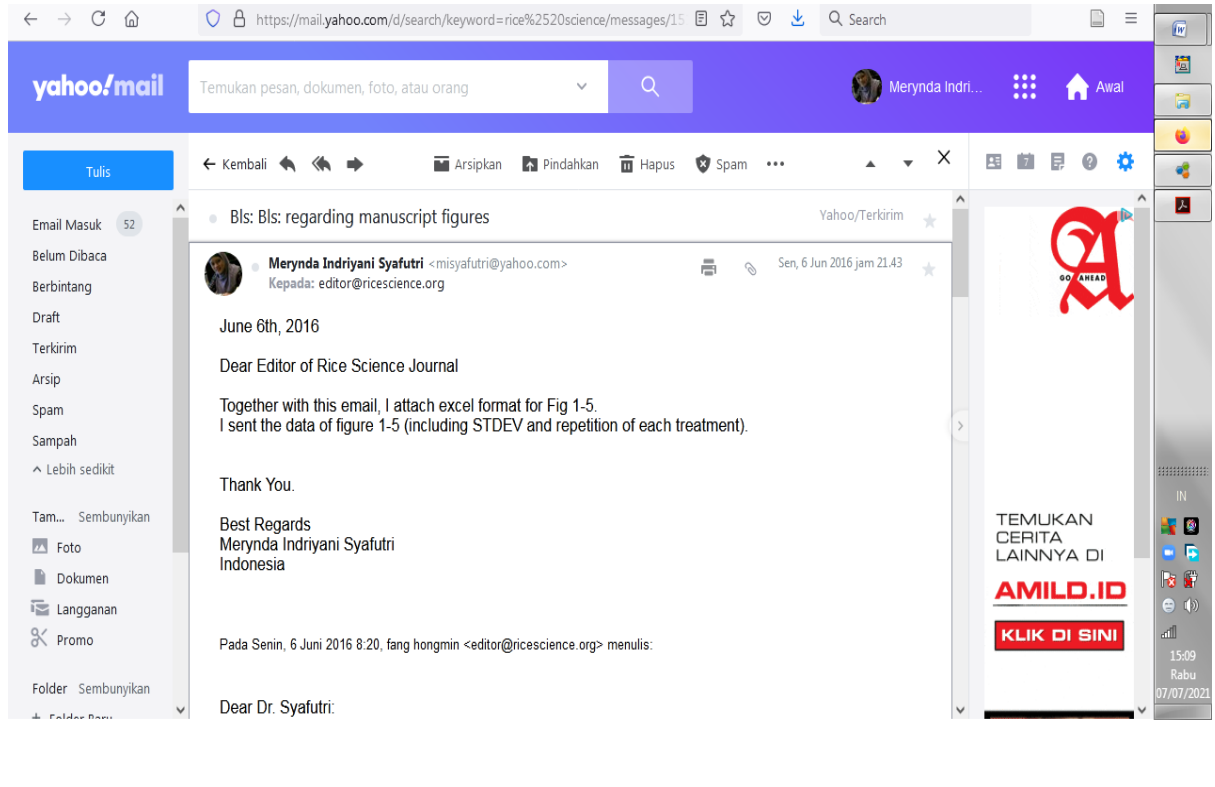
Sincerely yours

Editorial Office of Rice Science

CHINA NATIONAL RICE RESEARCH INSTITUTE

<xmlnamespace="" prefix="" ns="" />Tiyuchang Road No. 359,

Hangzhou 310006, CHINA



Bls: Bls: regarding manuscript figures
Yahoo/Terkirim

Merynda Indriyani Syafutri <misyafutri@yahoo.com>
Kepada: editor@ricescience.org
Sen, 6 Jun 2016 jam 21.43

June 6th, 2016

Dear Editor of Rice Science Journal

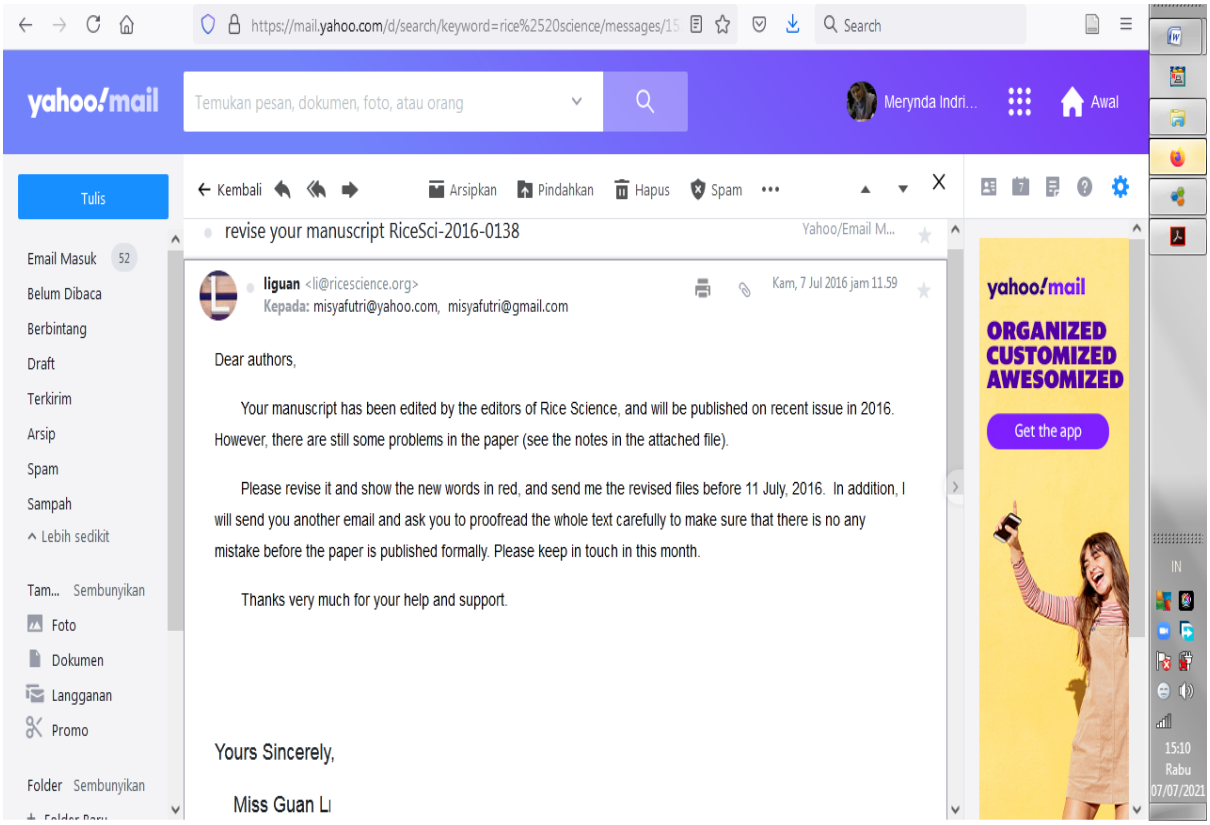
Together with this email, I attach excel format for Fig 1-5.
I sent the data of figure 1-5 (including STDEV and repetition of each treatment).

Thank You.

Best Regards
Merynda Indriyani Syafutri
Indonesia

Pada Senin, 6 Juni 2016 8:20, fang hongmin <editor@ricescience.org> menulis:

Dear Dr. Syafutri:



revise your manuscript RiceSci-2016-0138

liguan <li@ricescience.org>
Kepada: misyafutri@yahoo.com, misyafutri@gmail.com
Kam, 7 Jul 2016 jam 11.59

Dear authors,

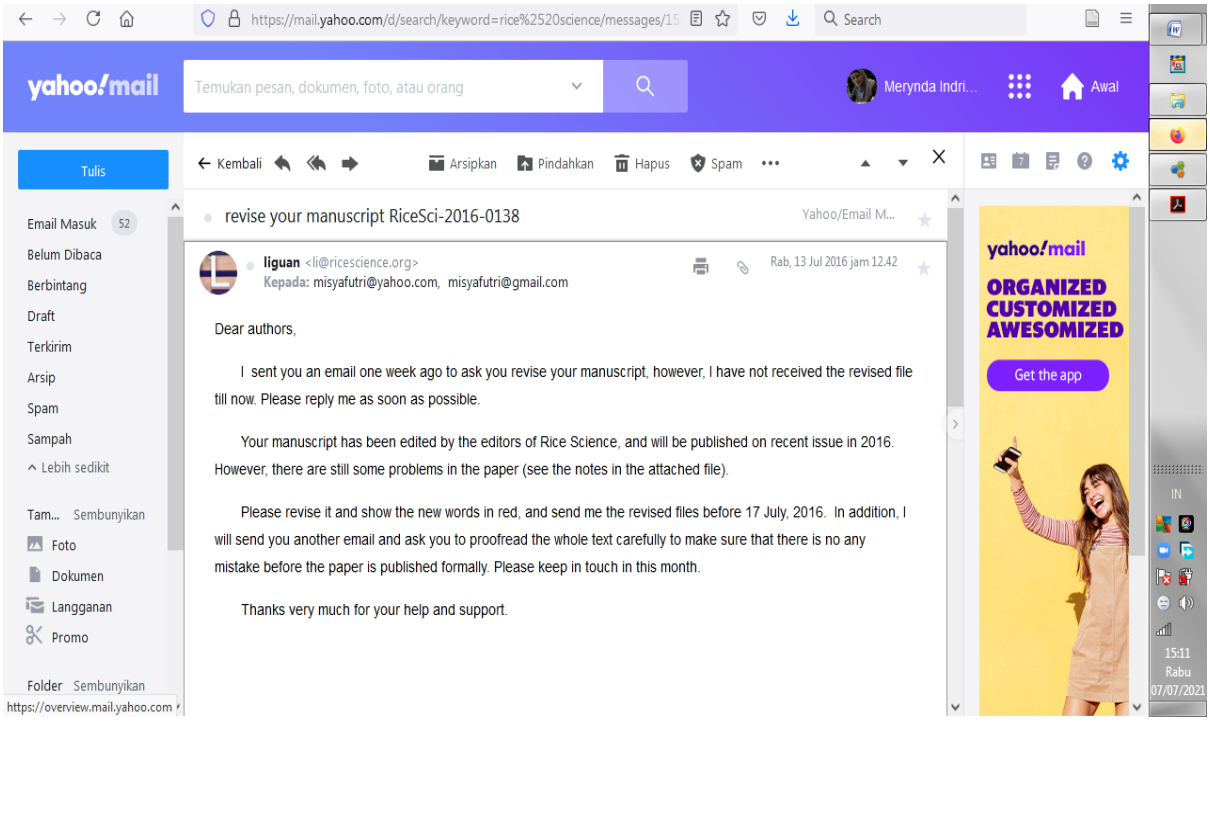
Your manuscript has been edited by the editors of Rice Science, and will be published on recent issue in 2016. However, there are still some problems in the paper (see the notes in the attached file).

Please revise it and show the new words in red, and send me the revised files before 11 July, 2016. In addition, I will send you another email and ask you to proofread the whole text carefully to make sure that there is no any mistake before the paper is published formally. Please keep in touch in this month.

Thanks very much for your help and support.

Yours Sincerely,

Miss Guan Li



revise your manuscript RiceSci-2016-0138

liguan <li@ricescience.org>
Kepada: misyafutri@yahoo.com, misyafutri@gmail.com
Rab, 13 Jul 2016 jam 12.42

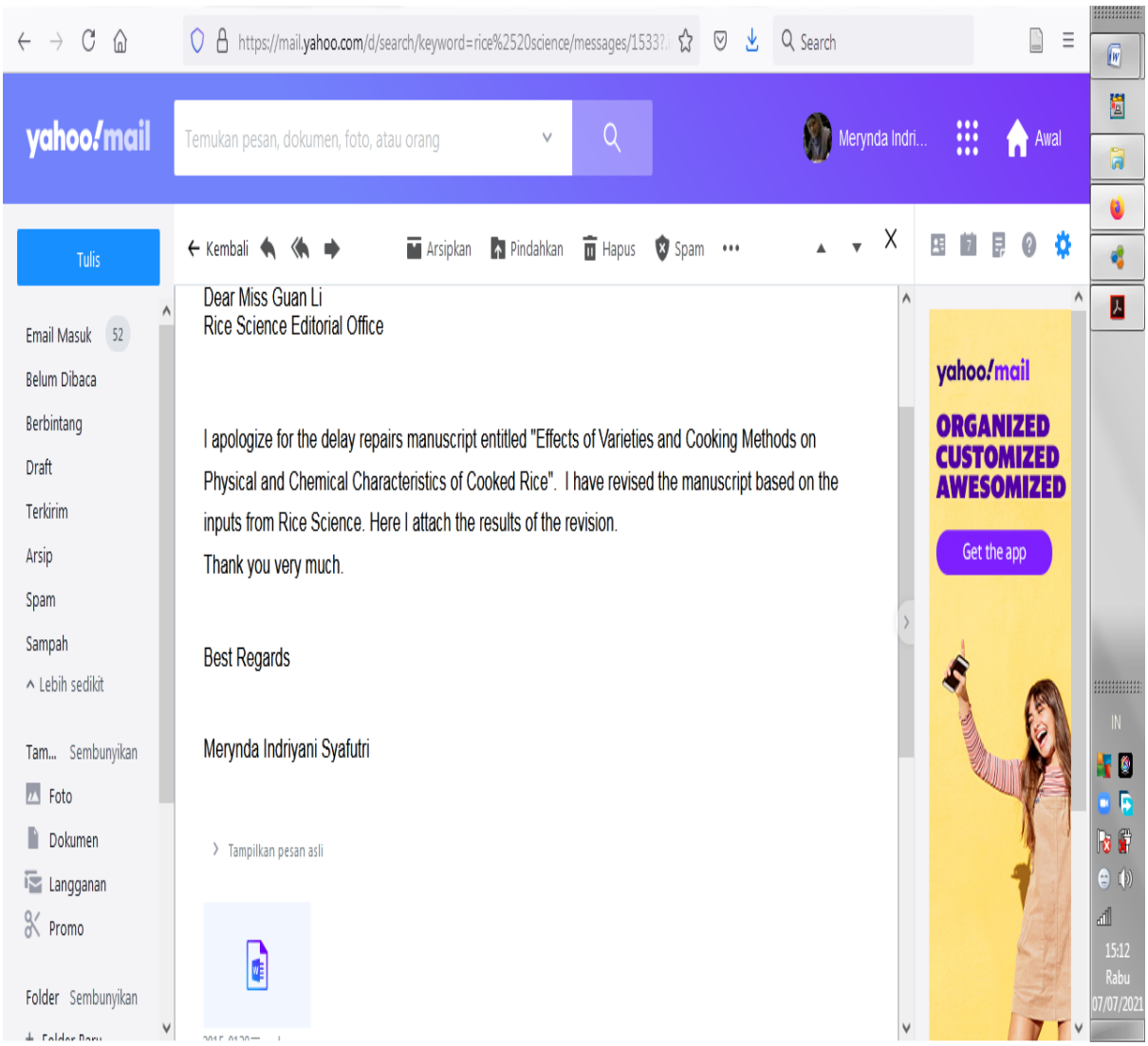
Dear authors,

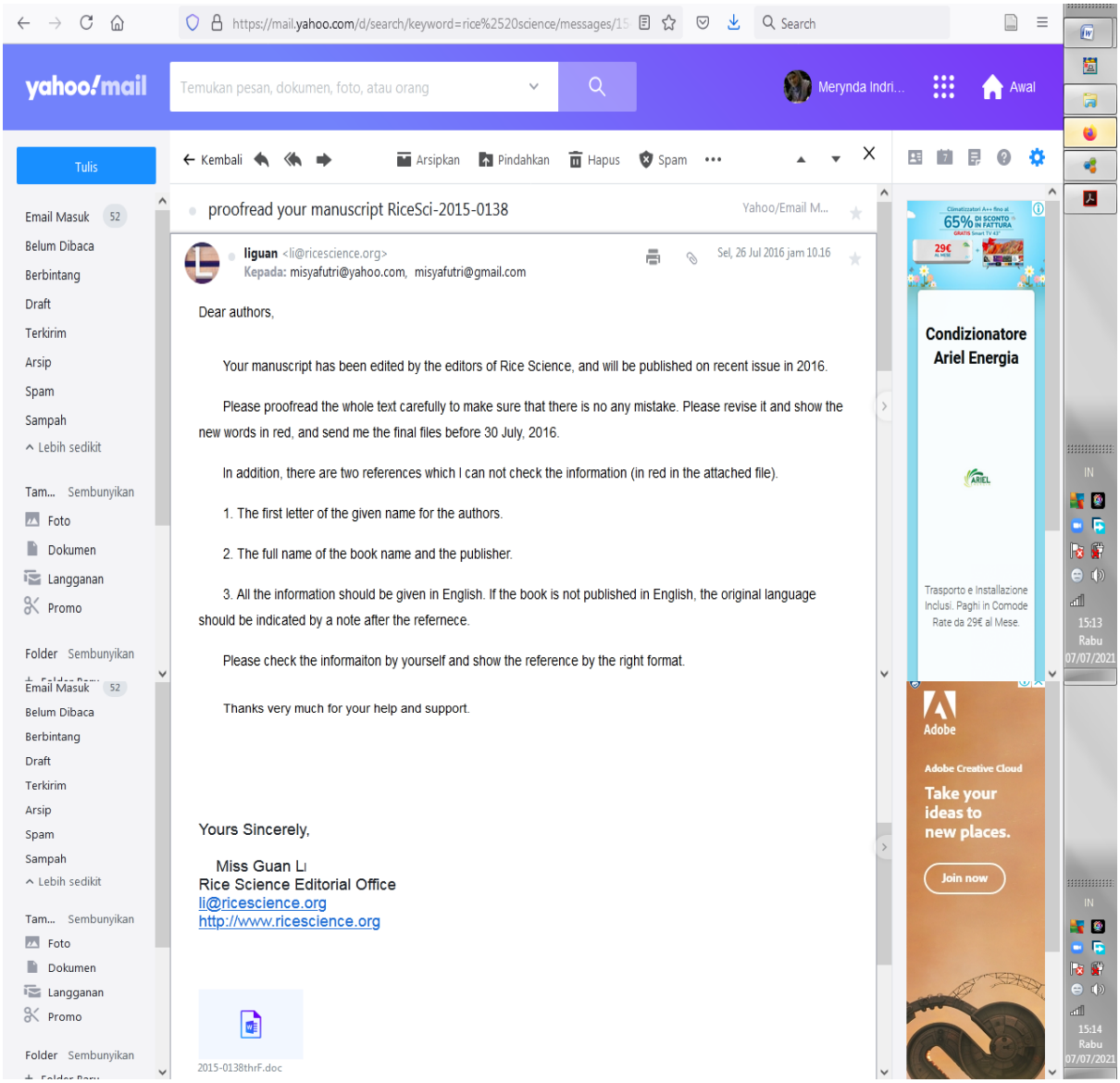
I sent you an email one week ago to ask you revise your manuscript, however, I have not received the revised file till now. Please reply me as soon as possible.

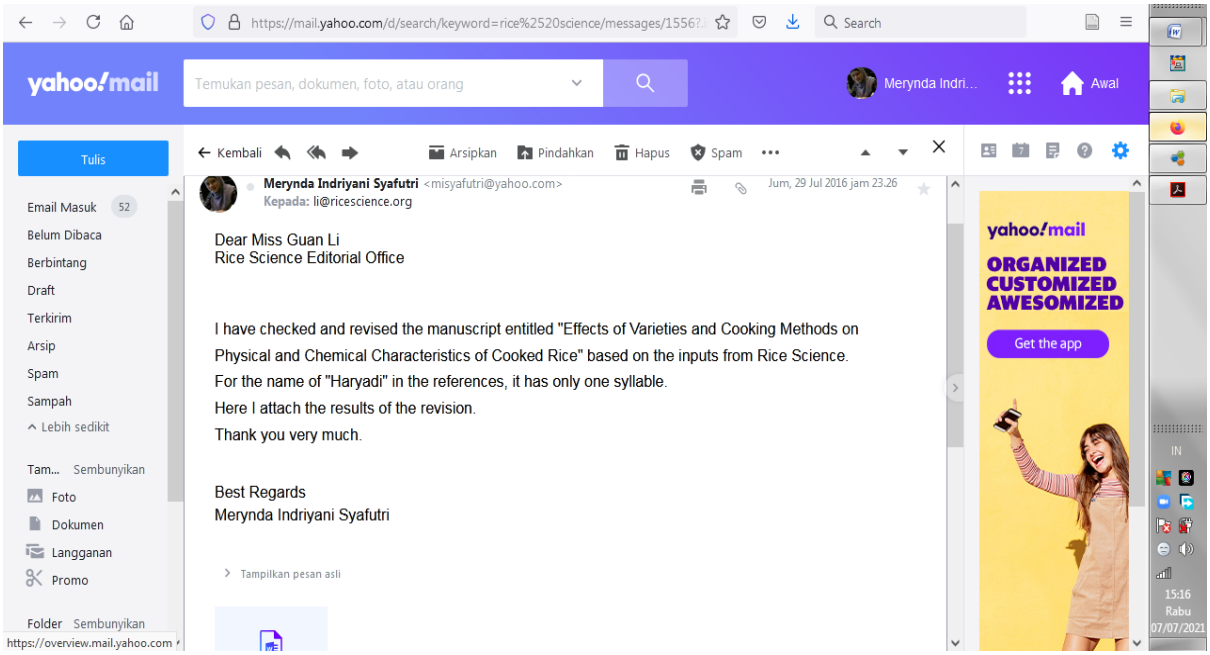
Your manuscript has been edited by the editors of Rice Science, and will be published on recent issue in 2016. However, there are still some problems in the paper (see the notes in the attached file).

Please revise it and show the new words in red, and send me the revised files before 17 July, 2016. In addition, I will send you another email and ask you to proofread the whole text carefully to make sure that there is no any mistake before the paper is published formally. Please keep in touch in this month.

Thanks very much for your help and support.


https://mail.yahoo.com/d/search/keyword=rice%2520science/messages/1533?..
Search
yahoo!mail
Temukan pesan, dokumen, foto, atau orang
Merynda Indri...
Awal
Tulis
Email Masuk 52
Belum Dibaca
Berbintang
Draft
Terkirim
Arsip
Spam
Sampah
Lebih sedikit
Tam... Sembunyikan
Foto
Dokumen
Langganan
Promo
Folder Sembunyikan
Kembali
Arsipkan
Pindahkan
Hapus
Spam
Dear Miss Guan Li
Rice Science Editorial Office
I apologize for the delay repairs manuscript entitled "Effects of Varieties and Cooking Methods on Physical and Chemical Characteristics of Cooked Rice". I have revised the manuscript based on the inputs from Rice Science. Here I attach the results of the revision.
Thank you very much.
Best Regards
Merynda Indriyani Syafutri
Tampilkan pesan asli
yahoo!mail
ORGANIZED
CUSTOMIZED
AWESOMIZED
Get the app
IN
15:12
Rabu
07/07/2021


yahoo!mail
Temukan pesan, dokumen, foto, atau orang
Merynda Indri...
Awal
Tulis
Email Masuk 52
Belum Dibaca
Berbintang
Draft
Terkirim
Arsip
Spam
Sampah
Lebih sedikit
Tam... Sembunyikan
Foto
Dokumen
Langganan
Promo
Folder Sembunyikan
Kembali
Arsipkan
Pindahkan
Hapus
Spam
proofread your manuscript RiceSci-2015-0138
Yahoo/Email M...
liguan <li@ricescience.org>
Kepada: misyafutri@yahoo.com, misyafutri@gmail.com
Sel, 26 Jul 2016 jam 10.16
Dear authors,
Your manuscript has been edited by the editors of Rice Science, and will be published on recent issue in 2016.
Please proofread the whole text carefully to make sure that there is no any mistake. Please revise it and show the new words in red, and send me the final files before 30 July, 2016.
In addition, there are two references which I can not check the information (in red in the attached file).
1. The first letter of the given name for the authors.
2. The full name of the book name and the publisher.
3. All the information should be given in English. If the book is not published in English, the original language should be indicated by a note after the refernece.
Please check the informaiton by yourself and show the reference by the right format.
Thanks very much for your help and support.
Yours Sincerely,
Miss Guan Li
Rice Science Editorial Office
li@ricescience.org
http://www.ricescience.org
2015-0138thrF.doc
65% DI SCONTO IN FATTURA
29€
Condizionatore Ariel Energia
Trasporto e Installazione Inclusi. Paghi in Comode Rate da 29€ al Mese.
Adobe
Adobe Creative Cloud
Take your ideas to new places.
Join now
15:13
Rabu
07/07/2021
15:14
Rabu
07/07/2021



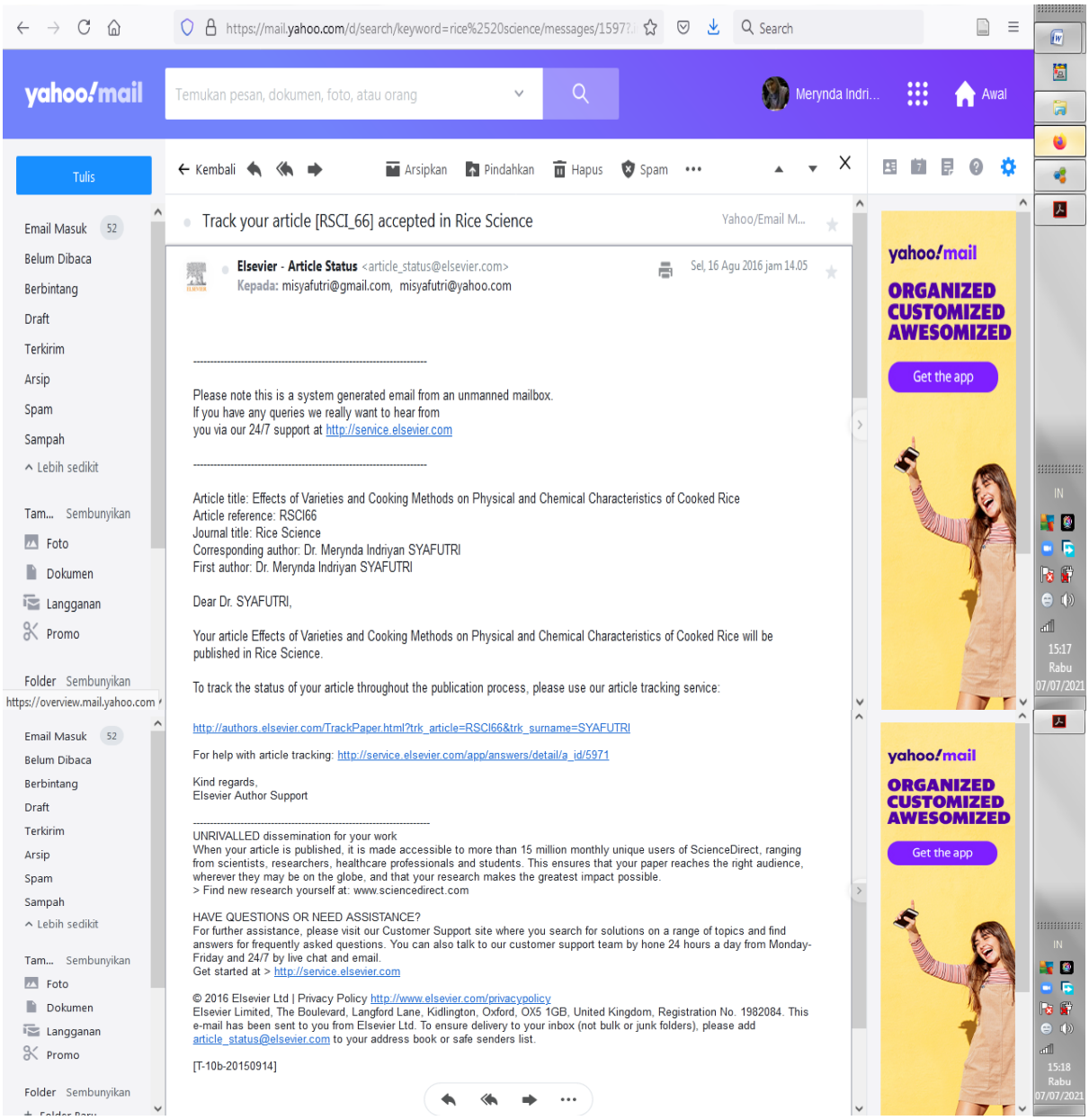
Merynda Indriyani Syafutri <misyafutri@yahoo.com>
Kepada: li@ricescience.org

Jum, 29 Jul 2016 jam 23.26

Dear Miss Guan Li
Rice Science Editorial Office

I have checked and revised the manuscript entitled "Effects of Varieties and Cooking Methods on Physical and Chemical Characteristics of Cooked Rice" based on the inputs from Rice Science.
For the name of "Haryadi" in the references, it has only one syllable.
Here I attach the results of the revision.
Thank you very much.

Best Regards
Merynda Indriyani Syafutri



Track your article [RSCI_66] accepted in Rice Science

Elsevier - Article Status <article_status@elsevier.com>
Kepada: misyafutri@gmail.com, misyafutri@yahoo.com

Sel, 16 Agu 2016 jam 14.05

Please note this is a system generated email from an unmanned mailbox.
If you have any queries we really want to hear from
you via our 24/7 support at http://service.elsevier.com

Article title: Effects of Varieties and Cooking Methods on Physical and Chemical Characteristics of Cooked Rice
Article reference: RSCI66
Journal title: Rice Science
Corresponding author: Dr. Merynda Indriyan SYAFUTRI
First author: Dr. Merynda Indriyan SYAFUTRI

Dear Dr. SYAFUTRI,

Your article Effects of Varieties and Cooking Methods on Physical and Chemical Characteristics of Cooked Rice will be published in Rice Science.

To track the status of your article throughout the publication process, please use our article tracking service:

http://authors.elsevier.com/TrackPaper.html?trk_article=RSCI66&trk_surname=SYAFUTRI

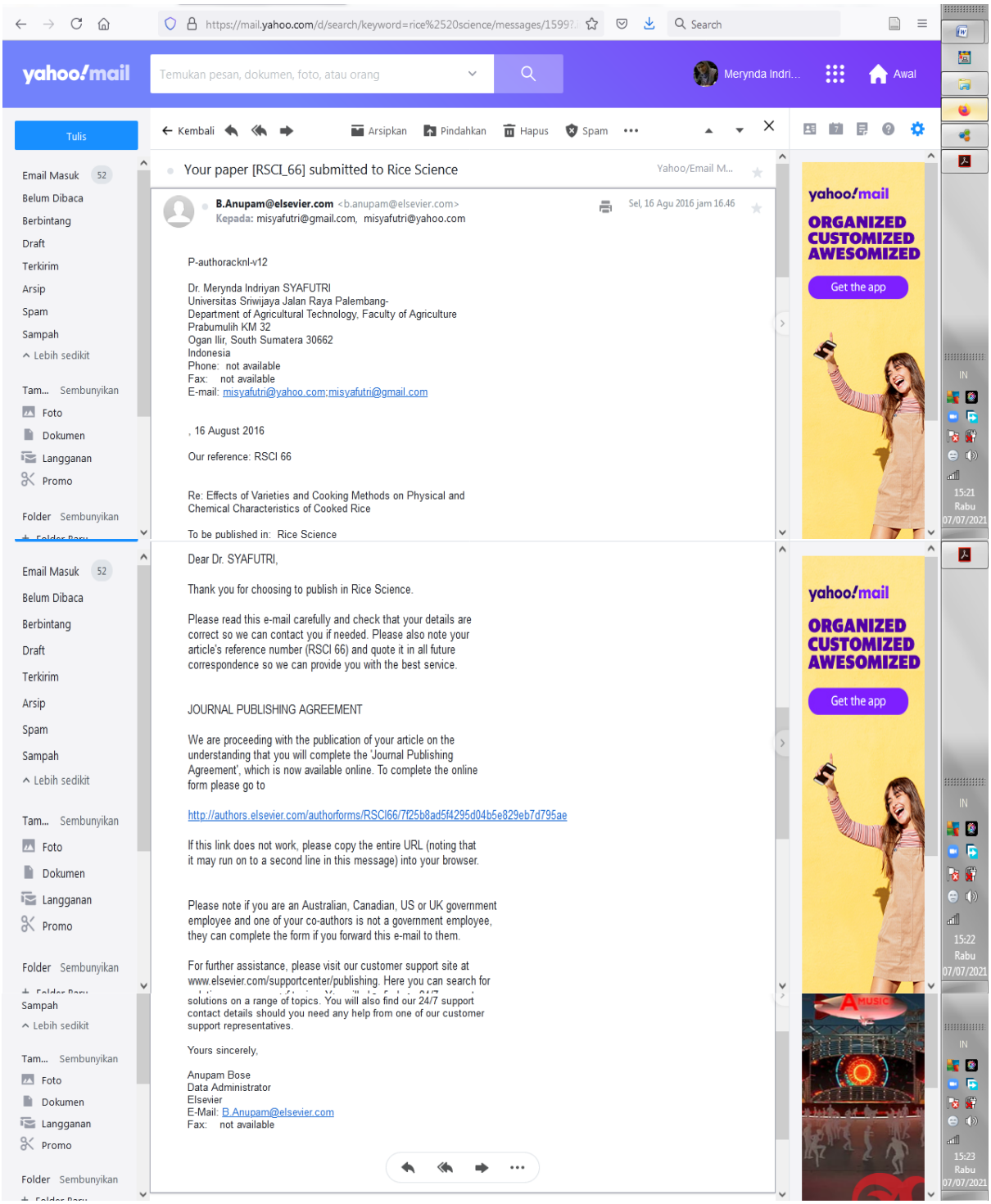
For help with article tracking: http://service.elsevier.com/app/answers/detail/a_id/5971

Kind regards,
Elsevier Author Support

UNRIVALLED dissemination for your work
When your article is published, it is made accessible to more than 15 million monthly unique users of ScienceDirect, ranging from scientists, researchers, healthcare professionals and students. This ensures that your paper reaches the right audience, wherever they may be on the globe, and that your research makes the greatest impact possible.
> Find new research yourself at: www.sciencedirect.com

HAVE QUESTIONS OR NEED ASSISTANCE?
For further assistance, please visit our Customer Support site where you search for solutions on a range of topics and find answers for frequently asked questions. You can also talk to our customer support team by hone 24 hours a day from Monday-Friday and 24/7 by live chat and email.
Get started at > http://service.elsevier.com

[T-10b-20150914]



Your paper [RSCI_66] submitted to Rice Science

B.Anupam@elsevier.com <b.anupam@elsevier.com>
Kepada: misyafutri@gmail.com, misyafutri@yahoo.com

Sel, 16 Agu 2016 jam 16.46

P-authoracknl-v12

Dr. Merynda Indriyan SYAFUTRI
Universitas Sriwijaya Jalan Raya Palembang-
Department of Agricultural Technology, Faculty of Agriculture
Prabumulih KM 32
Ogan Ilir, South Sumatera 30662
Indonesia
Phone: not available
Fax: not available
E-mail: misyafutri@yahoo.com;misyafutri@gmail.com

, 16 August 2016

Our reference: RSCI 66

Re: Effects of Varieties and Cooking Methods on Physical and Chemical Characteristics of Cooked Rice

To be published in: Rice Science

Dear Dr. SYAFUTRI,

Thank you for choosing to publish in Rice Science.

Please read this e-mail carefully and check that your details are correct so we can contact you if needed. Please also note your article's reference number (RSCI 66) and quote it in all future correspondence so we can provide you with the best service.

JOURNAL PUBLISHING AGREEMENT

We are proceeding with the publication of your article on the understanding that you will complete the 'Journal Publishing Agreement', which is now available online. To complete the online form please go to

http://authors.elsevier.com/authorforms/RSCI66/7f25b8ad5f4295d04b5e829eb7d795ae

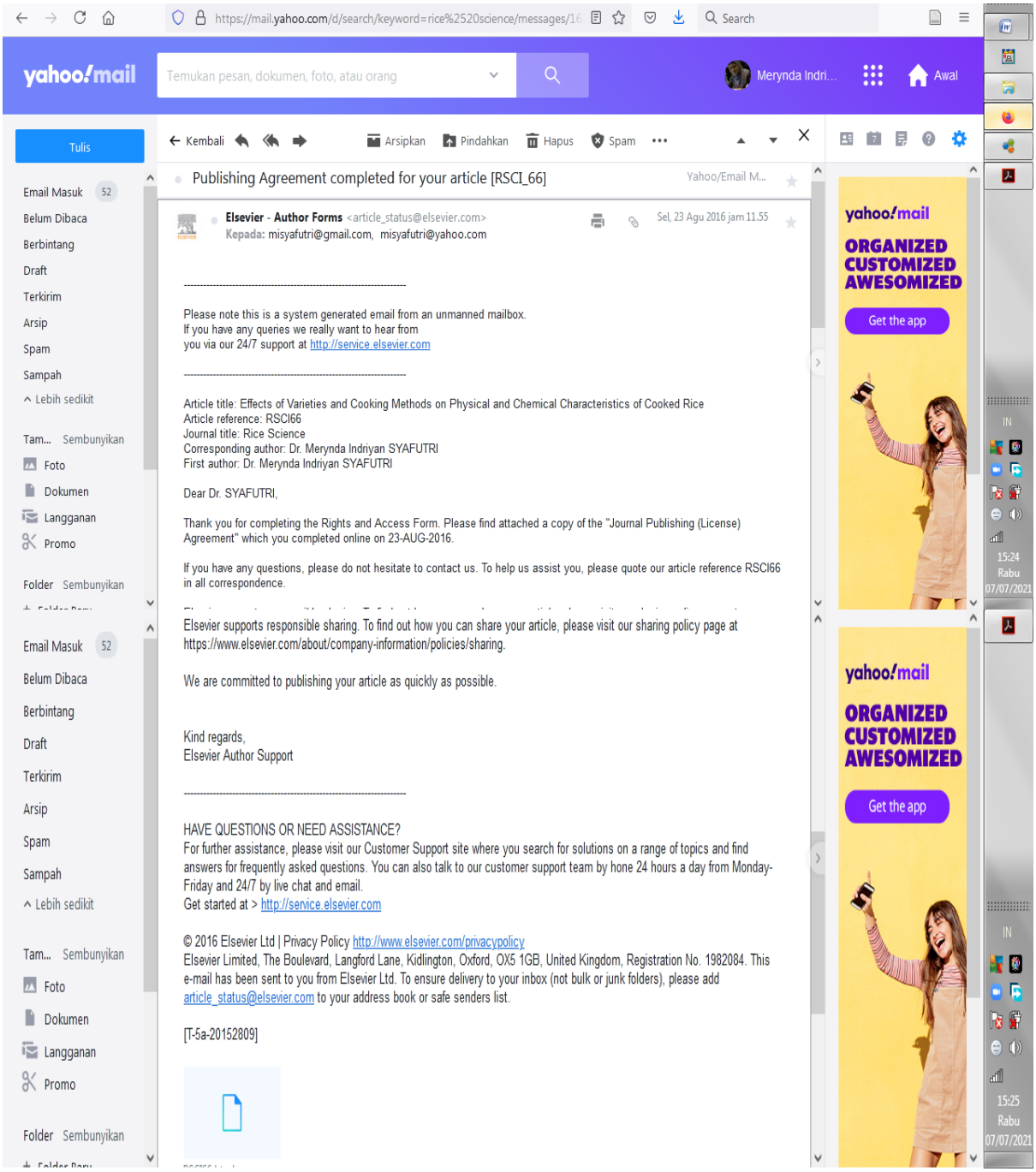
If this link does not work, please copy the entire URL (noting that it may run on to a second line in this message) into your browser.

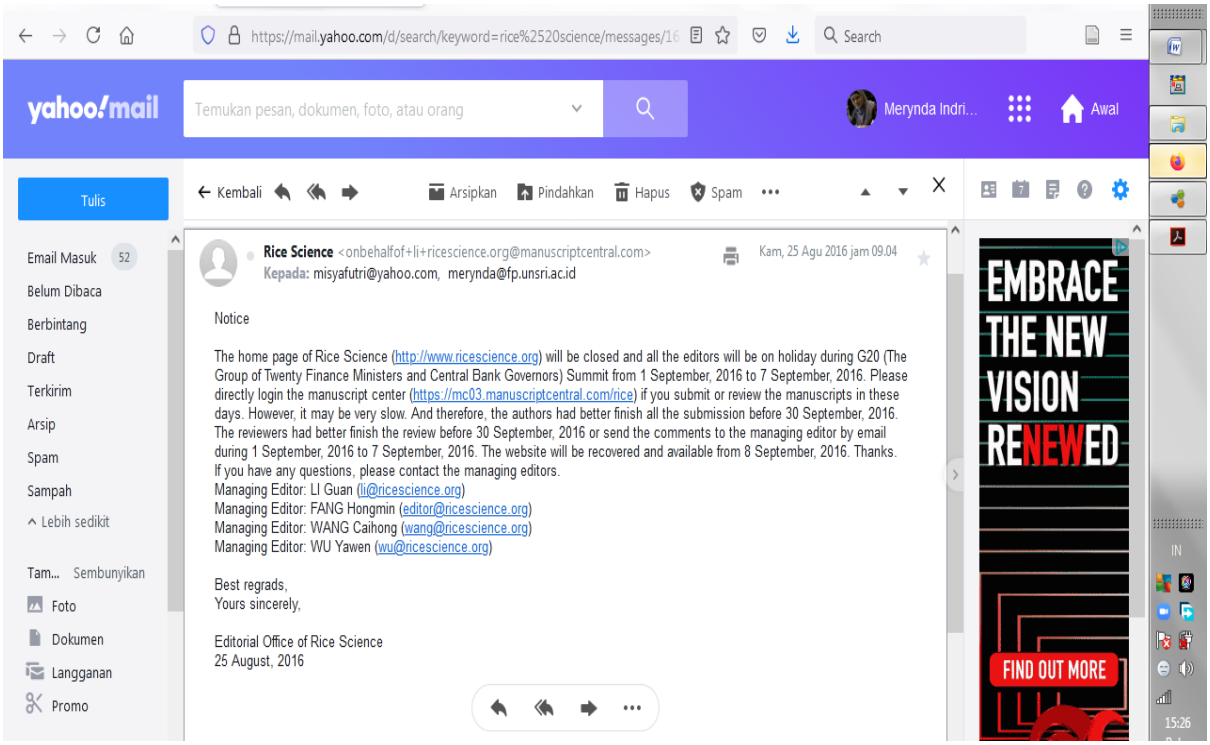
Please note if you are an Australian, Canadian, US or UK government employee and one of your co-authors is not a government employee, they can complete the form if you forward this e-mail to them.

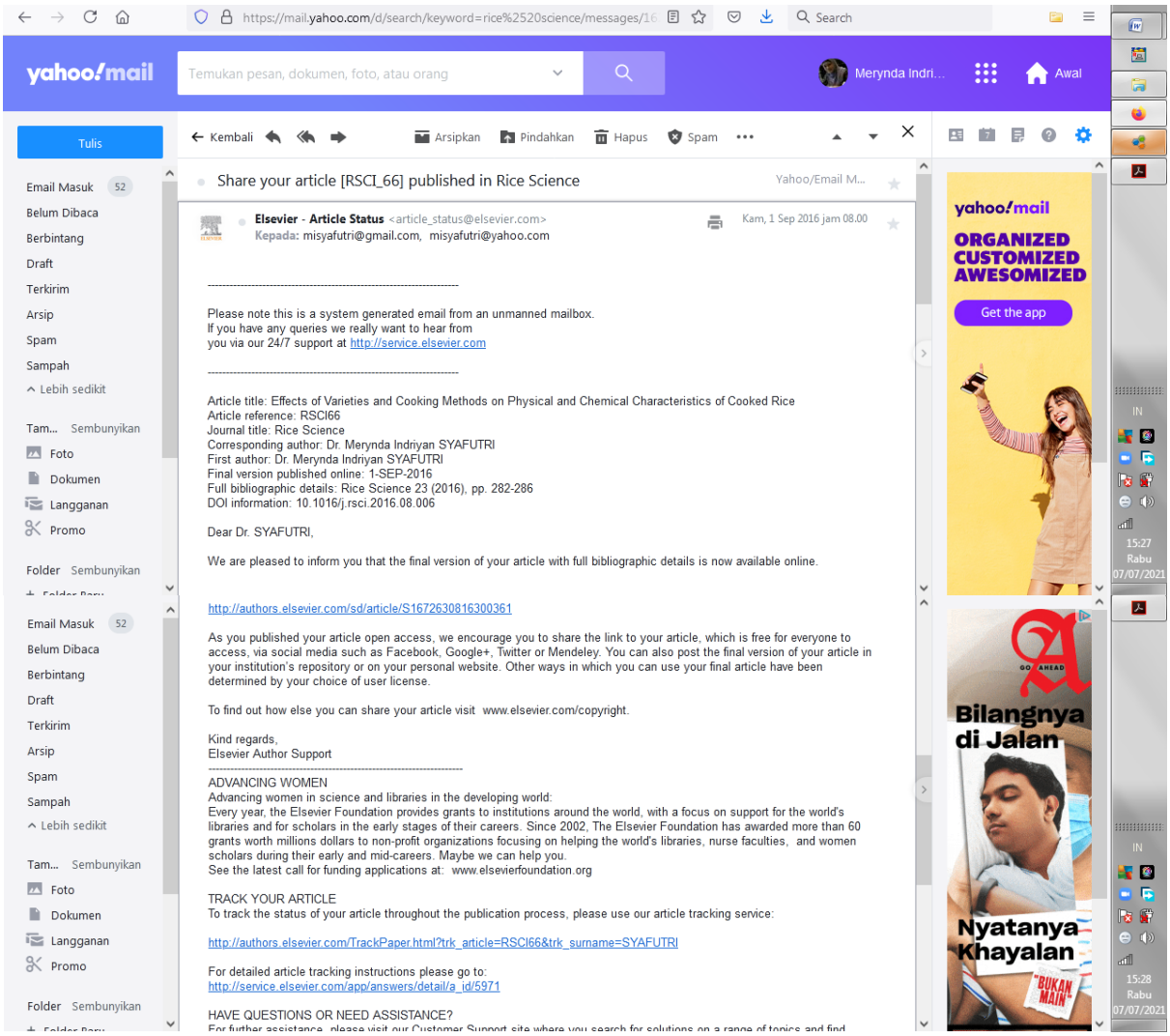
For further assistance, please visit our customer support site at www.elsevier.com/supportcenter/publishing. Here you can search for solutions on a range of topics. You will also find our 24/7 support contact details should you need any help from one of our customer support representatives.

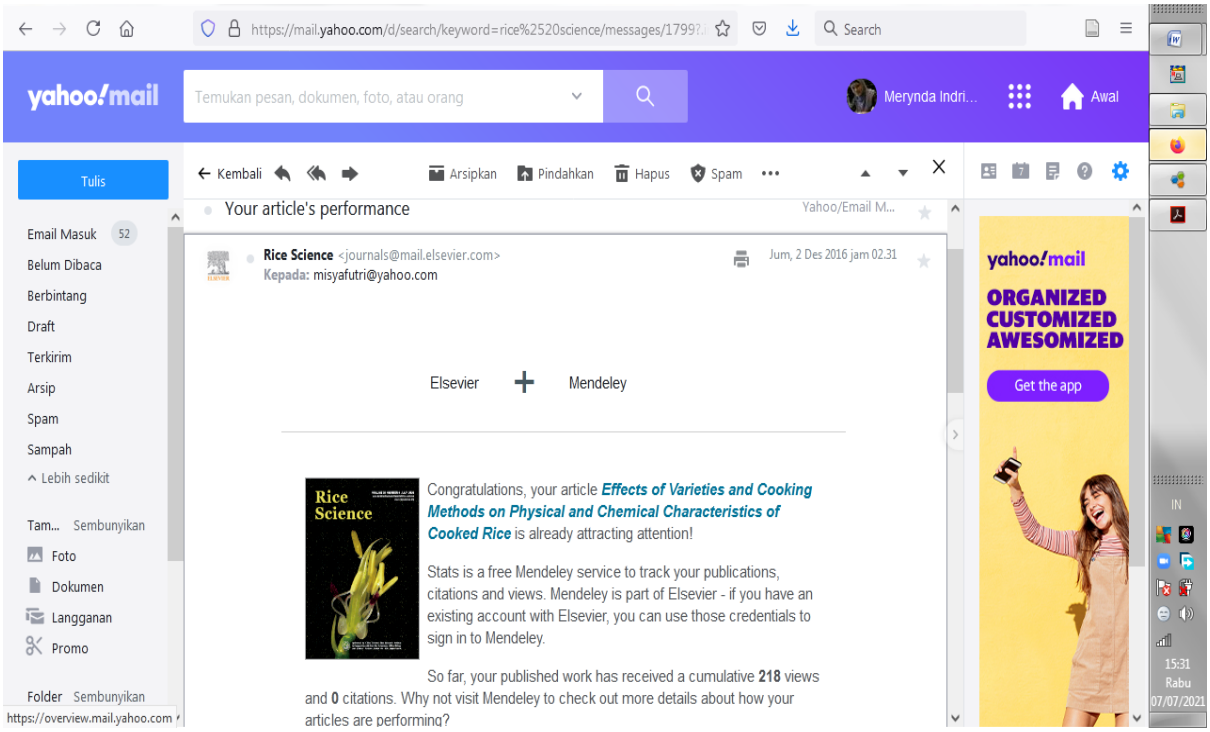
Yours sincerely,

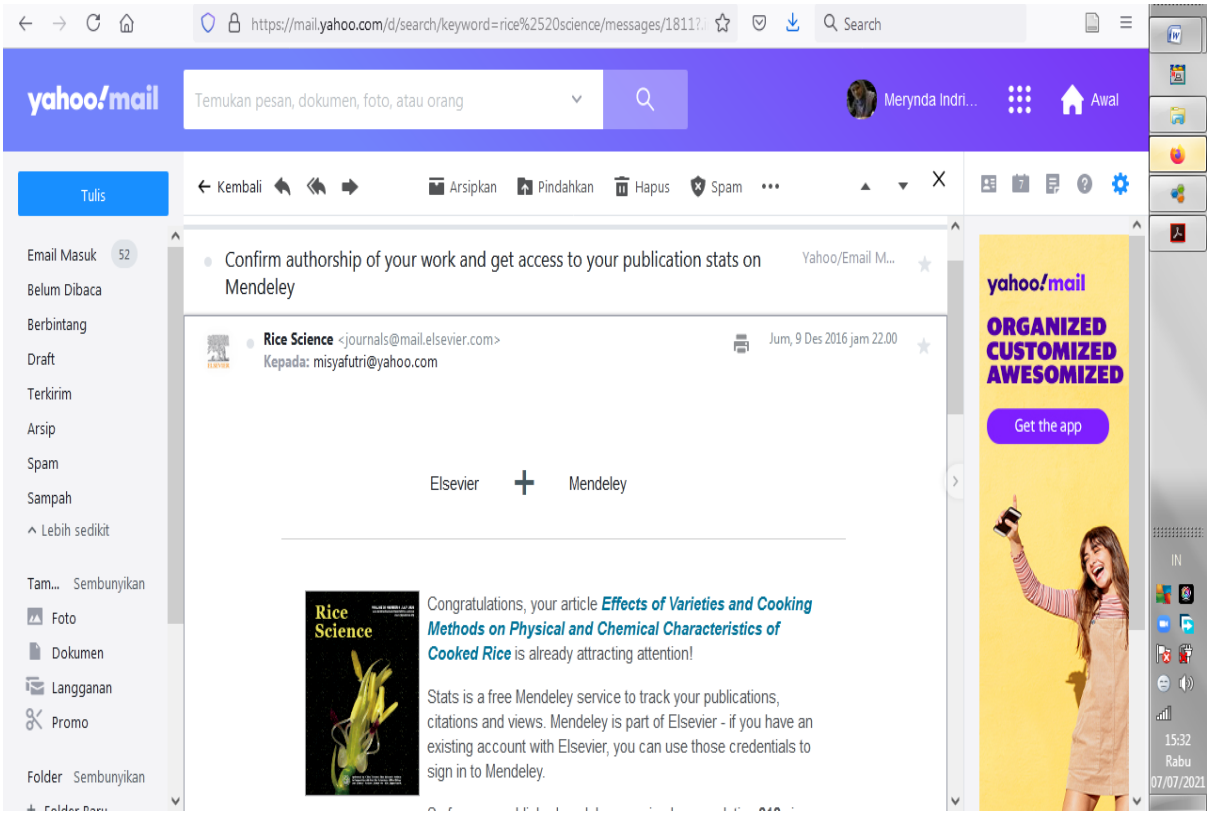
Anupam Bose
Data Administrator
Elsevier
E-Mail: B.Anupam@elsevier.com
Fax: not available


yahoo!mail
Temukan pesan, dokumen, foto, atau orang
Merynda Indri...
Awal
Tulis
Email Masuk 52
Belum Dibaca
Berbintang
Draft
Terkirim
Arsip
Spam
Sampah
Lebih sedikit
Tam... Sembunyikan
Foto
Dokumen
Langganan
Promo
Folder Sembunyikan
Kembali
Arsipkan
Pindahkan
Hapus
Spam
Publishing Agreement completed for your article [RSCI_66]
Yahoo/Email M...
Elsevier - Author Forms <article_status@elsevier.com>
Kepada: misyafutri@gmail.com, misyafutri@yahoo.com
Sel, 23 Agu 2016 jam 11.55
Please note this is a system generated email from an unmanned mailbox.
If you have any queries we really want to hear from
you via our 24/7 support at http://service.elsevier.com
Article title: Effects of Varieties and Cooking Methods on Physical and Chemical Characteristics of Cooked Rice
Article reference: RSCI66
Journal title: Rice Science
Corresponding author: Dr. Merynda Indriyan SYAFUTRI
First author: Dr. Merynda Indriyan SYAFUTRI
Dear Dr. SYAFUTRI,
Thank you for completing the Rights and Access Form. Please find attached a copy of the "Journal Publishing (License) Agreement" which you completed online on 23-AUG-2016.
If you have any questions, please do not hesitate to contact us. To help us assist you, please quote our article reference RSCI66 in all correspondence.
Elsevier supports responsible sharing. To find out how you can share your article, please visit our sharing policy page at https://www.elsevier.com/about/company-information/policies/sharing.
We are committed to publishing your article as quickly as possible.
Kind regards,
Elsevier Author Support
HAVE QUESTIONS OR NEED ASSISTANCE?
For further assistance, please visit our Customer Support site where you search for solutions on a range of topics and find answers for frequently asked questions. You can also talk to our customer support team by hone 24 hours a day from Monday-Friday and 24/7 by live chat and email.
Get started at > http://service.elsevier.com
© 2016 Elsevier Ltd | Privacy Policy http://www.elsevier.com/privacypolicy
Elsevier Limited, The Boulevard, Langford Lane, Kidlington, Oxford, OX5 1GB, United Kingdom, Registration No. 1982084. This e-mail has been sent to you from Elsevier Ltd. To ensure delivery to your inbox (not bulk or junk folders), please add article_status@elsevier.com to your address book or safe senders list.
[T-5a-20152809]
ORGANIZED
CUSTOMIZED
AWESOMIZED
Get the app
15:24
Rabu
07/07/2021
15:25


yahoo!mail
Temukan pesan, dokumen, foto, atau orang
Merynda Indri...
Awal
Tulis
Kembali
Arsipkan
Pindahkan
Hapus
Spam
Email Masuk 52
Belum Dibaca
Berbintang
Draft
Terkirim
Arsip
Spam
Sampah
Lebih sedikit
Tam... Sembunyikan
Foto
Dokumen
Langganan
Promo
Rice Science <onbehalfof+li+ricescience.org@manuscriptcentral.com>
Kepada: misyafutri@yahoo.com, merynda@fp.unsri.ac.id
Kam, 25 Agu 2016 jam 09.04
Notice
The home page of Rice Science (http://www.ricescience.org) will be closed and all the editors will be on holiday during G20 (The Group of Twenty Finance Ministers and Central Bank Governors) Summit from 1 September, 2016 to 7 September, 2016. Please directly login the manuscript center (https://mc03.manuscriptcentral.com/rice) if you submit or review the manuscripts in these days. However, it may be very slow. And therefore, the authors had better finish all the submission before 30 September, 2016. The reviewers had better finish the review before 30 September, 2016 or send the comments to the managing editor by email during 1 September, 2016 to 7 September, 2016. The website will be recovered and available from 8 September, 2016. Thanks.
If you have any questions, please contact the managing editors.
Managing Editor: LI Guan (li@ricescience.org)
Managing Editor: FANG Hongmin (editor@ricescience.org)
Managing Editor: WANG Caihong (wang@ricescience.org)
Managing Editor: WU Yawen (wu@ricescience.org)
Best regrads,
Yours sincerely,
Editorial Office of Rice Science
25 August, 2016
EMBRACE THE NEW VISION RENEWED
FIND OUT MORE


yahoo!mail
Temukan pesan, dokumen, foto, atau orang
Merynda Indri...
Awal
Tulis
Kembali
Arsipkan
Pindahkan
Hapus
Spam
Share your article [RSCI_66] published in Rice Science
Yahoo/Email M...
Elsevier - Article Status <article_status@elsevier.com>
Kepada: misyafutri@gmail.com, misyafutri@yahoo.com
Kam, 1 Sep 2016 jam 08.00
Please note this is a system generated email from an unmanned mailbox.
If you have any queries we really want to hear from
you via our 24/7 support at http://service.elsevier.com
Article title: Effects of Varieties and Cooking Methods on Physical and Chemical Characteristics of Cooked Rice
Article reference: RSCI66
Journal title: Rice Science
Corresponding author: Dr. Merynda Indriyan SYAFUTRI
First author: Dr. Merynda Indriyan SYAFUTRI
Final version published online: 1-SEP-2016
Full bibliographic details: Rice Science 23 (2016), pp. 282-286
DOI information: 10.1016/j.rsci.2016.08.006
Dear Dr. SYAFUTRI,
We are pleased to inform you that the final version of your article with full bibliographic details is now available online.
http://authors.elsevier.com/sd/article/S1672630816300361
As you published your article open access, we encourage you to share the link to your article, which is free for everyone to access, via social media such as Facebook, Google+, Twitter or Mendeley. You can also post the final version of your article in your institution's repository or on your personal website. Other ways in which you can use your final article have been determined by your choice of user license.
To find out how else you can share your article visit www.elsevier.com/copyright.
Kind regards,
Elsevier Author Support
ADVANCING WOMEN
Advancing women in science and libraries in the developing world:
Every year, the Elsevier Foundation provides grants to institutions around the world, with a focus on support for the world's libraries and for scholars in the early stages of their careers. Since 2002, The Elsevier Foundation has awarded more than 60 grants worth millions dollars to non-profit organizations focusing on helping the world's libraries, nurse faculties, and women scholars during their early and mid-careers. Maybe we can help you.
See the latest call for funding applications at: www.elsevierfoundation.org
TRACK YOUR ARTICLE
To track the status of your article throughout the publication process, please use our article tracking service:
http://authors.elsevier.com/TrackPaper.html?trk_article=RSCI66&trk_surname=SYAFUTRI
For detailed article tracking instructions please go to:
http://service.elsevier.com/app/answers/detail/a_id/5971
HAVE QUESTIONS OR NEED ASSISTANCE?
yahoo!mail
ORGANIZED CUSTOMIZED AWESOMIZED
Get the app
Bilangnya di Jalan
Nyatanya Khayalan
BUKAN MAIN


yahoo!mail
Temukan pesan, dokumen, foto, atau orang
Merynda Indri...
Awal
Tulis
Kembali
Arsipkan
Pindahkan
Hapus
Spam
Email Masuk 52
Belum Dibaca
Berbintang
Draft
Terkirim
Arsip
Spam
Sampah
Lebih sedikit
Tam... Sembunyikan
Foto
Dokumen
Langganan
Promo
Folder Sembunyikan
Your article's performance
Yahoo/Email M...
Rice Science <journals@mail.elsevier.com>
Kepada: misyafutri@yahoo.com
Jum, 2 Des 2016 jam 02.31
Elsevier + Mendeley
Rice Science
Congratulations, your article Effects of Varieties and Cooking Methods on Physical and Chemical Characteristics of Cooked Rice is already attracting attention!
Stats is a free Mendeley service to track your publications, citations and views. Mendeley is part of Elsevier - if you have an existing account with Elsevier, you can use those credentials to sign in to Mendeley.
So far, your published work has received a cumulative 218 views and 0 citations. Why not visit Mendeley to check out more details about how your articles are performing?
yahoo!mail
ORGANIZED
CUSTOMIZED
AWESOMIZED
Get the app
https://overview.mail.yahoo.com
15:31
Rabu
07/07/2021


yahoo!mail
Temukan pesan, dokumen, foto, atau orang
Merynda Indri...
Awal
Tulis
Kembali
Arsipkan
Pindahkan
Hapus
Spam
Email Masuk 52
Belum Dibaca
Berbintang
Draft
Terkirim
Arsip
Spam
Sampah
Lebih sedikit
Tam... Sembunyikan
Foto
Dokumen
Langganan
Promo
Folder Sembunyikan
Confirm authorship of your work and get access to your publication stats on Mendeley
Yahoo/Email M...
Rice Science <journals@mail.elsevier.com>
Kepada: misyafutri@yahoo.com
Jum, 9 Des 2016 jam 22.00
Elsevier + Mendeley
Rice Science
Congratulations, your article Effects of Varieties and Cooking Methods on Physical and Chemical Characteristics of Cooked Rice is already attracting attention!
Stats is a free Mendeley service to track your publications, citations and views. Mendeley is part of Elsevier - if you have an existing account with Elsevier, you can use those credentials to sign in to Mendeley.
yahoo!mail
ORGANIZED
CUSTOMIZED
AWESOMIZED
Get the app
15:32
Rabu
07/07/2021

The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods

Abstract : The objective of the research was to analyze the effect of different lowland rice varieties and different cooking methods on physical and chemical properties of cooked rice. The research used a factorial Randomized Block Design with two factors and each combination of the factors was repeated three times. The first factor was rice variety (A_1: Ciherang variety, A_2: Ciliwung variety) and the second factor was the cooking method (B_1: stovetop, B_2: boiled and steamed, B_3: rice cooker). Milled rice of Ciherang variety had the ratio between length and width was 3.44, lightness of 65.97%, chroma 12.03%, hue 69.37^o, moisture content 12.27%, amylose content 22.64%, protein content 10.73%, total amino acid 7.75%. Milled rice of Ciliwung variety had the ratio between length and width was 3.21, lightness of 67.93%, chroma 12.00%, hue 65.70^o, moisture content 12.22%, amylose content 18.85%, protein content 8.98%, total amino acid content 6.98%. Results showed that the lightness of cooked rice was in the range of 73.07% to 76.20%, chroma 5.63% to 7.10%, hue 62.43^o to 68.20^o and texture 25.70 gf to 33.00 gf. Statistical analysis showed that cooking method had significant effect on texture, lightness, chroma, hue and moisture content of cooked rice.
Key words : cooking method; lowland rice varieties

Rice is one of the important commodity results in rice farming systems in lowland swamp. Lowland swamp land that has been cultivated for rice farming with cropping patterns once a year is 91%, while for rice farming with cropping twice a year only about 9% (Sudana, 2005). The varieties of rice grown in lowland swamp area consists of various varieties namely Ciherang, Ciliwung, Mekongga, IR 10, IR 42, IR 64, Ciherang Dempo, Ciliwung Jumbo, and Rojo Lele (Syafutri, 2015). Ciherang and Ciliwung are several varieties widely grown by farmers in lowland swamp land. The difference of rice varieties will affect the characteristics of cooked rice produced. According to Yadav et al (2007), different rice varieties showed significant effects on the physicochemical properties, morphology, and cooking properties, but Putri (2012) stated that the starch contents of rice were still the same ie more than 80%. Cooking method also affect the characteristics of cooked rice. According to Han et al (2008), different cooking method will affect the hydrolysis of starch rice. Cooking the raw rice into the cooked rice can be done in various ways. Indonesian people use two ways to cook rice namely conventional and modern way. The conventional way consist of *liwet* method using stovetop, and combination of boiling and steaming method. The modern way was cooking rice using electric rice cooker. Each cooking method uses different heat and long cooking. The objective of this study was to analyze the effect of different lowland rice varieties and different cooking methods on physical and chemical of cooked rice.

MATERIALS AND METHODS

Rice Materials

The rice used in this study derived from lowland swamp land at East OKU, South Sumatera, Indonesia. The varieties of rice were Ciherang and Ciliwung.

Methods

This study using Factorial Randomized Block Design with two treatment factors and repeated three times. The treatment factors were rice variety (A) and the cooking method (B). The first factor consisted of two levels : Ciherang (A_1) and Ciliwung (A_2), where as the second factor consisted of three levels : *liwet* method using stovetop (B_1), combination of boiled and steamed (B_2), and rice cooker (B_3). The data obtained performed using analysis of variance (ANOVA) 5% and HSD test. The parameters of this study were physical and chemical characteristics on milled rice and cooked rice. The physical characteristics of milled rice included dimensions rice and color, where as the chemical characteristics of milled rice included moisture content, amylose content, protein content and total amino acids. The physical characteristics of cooked rice were color and texture, while the chemical characteristic was moisture content.

Liwet Method using Stovetop

The procedurs of *liwet* method (Deliani, 2004) which has been modified were : first, milled rice with whole grains (100 g) cleared from foreign objects and dirt. Second, rice washed with clean water (2 times) and drained

for 2 minutes, then put in a regular pot or pan pot. Next step, water (150 mL) was added to the pot containing. Fourth, the rice cooked in a covered pot until boiling. Then, stirring done 10 times after boiling water (100°C). Sixth, if the water was up, stirred again (stirring the latter performed 5 times and the pot sealed while the fire diminished. Last, the cooking times of *liwet* method were 10 minutes.

Combination of Boiled and Steamed Method

The procedurs of boiled and steamed combination method (Deliani, 2004) which has been modified were : first, milled rice with whole grains (100 g) cleared from foreign objects and dirt. Second, rice washed with clean water (2 times) and drained for 2 minutes, then put in a regular pot or pan pot. Third, water (150 mL) was added to the pot containing. Next, the rice cooked in a covered pot to a boil for 5 minutes, then reduce the heat (during heating stirring 15 times until becoming rice (water absorbed by rice). Fifth, stirring done 10 times after boiling water (100°C) to become rice (water absorbed by rice). Then, rice stirred and moved to the steamer containing boiled water, then waited for 5 minutes.

Rice Cooker Method

The procedurs of modern cooking method (rice cooker) (Sutarjana, 2009) which has been modified were : first, milled rice with whole grains (100 g) cleared from foreign objects and dirt. Second, rice washed with clean water (2 times) and drained for 2 minutes and put in an aluminum pan on the rice cooker. Then, water (150 mL) was added. Fourth, thermostat clicked and light "cooking" light up on the rice cooker to cook the raw rice into the cooked rice. Finally, the thermostat button will automatically moved from the position of the light "cooking" to the position of the lights "warmer" that shows rice cooked.

Dimention of rice

Rice dimensions include length and width measured using calipers. Whole rice intact (10 seeds) taken from each variety. Seeds of rice measured length and width using calipers and the average was taken.

Texture

Texture of rice was measured with “Brookfield” texture analyzer (Faridah et al, 2006). Brook (cylindrical type) mounted just above the sample. The needle was attached to the tip of the sample. Brooke (blade type) pressing right in the middle of the sample. Then, on display listed number of peak load and final load (gram force).

Color

Analysis of color was measured using “Konica Minolta” Chromameter. Chromameter turned on and the button was activated to select and determine the values and numbers were used. The values that be used were Lightness (L), Chroma (C) and Hue (H). Samples of rice were placed under the lens of Chromameter and numbers of L (%), C (%), and H (^{o}) will be shown (Munsell, 1997).

Chemical Characteristics

The chemical characteristics included moisture content, amylose content, protein content and total amino acids. Moisture content, amylose content, protein content and total amino acids were determined using method of AOAC (2006).

RESULTS

Dimention of Rice

Variety of lowland swamp rice used for this study were Ciherang and Ciliwung. Dimention averages of Ciherang and Ciliwung varieties included length and width. Rice of Ciherang variety had length 7.01 mm and width 2.04 mm. Rice of Ciliwung variety had length of 6.75 mm and width of 2.10 mm. The ratio between length and width of Ciherang variety was 3.44, while the ratio between length and width of Ciliwung variety ratio was 3.21.

Texture

Texture indicated as hardness of rice that cooked with some cooking methods. Physically, hardness of rice defined as rice ability to accept certein load in certein time. Analysis of texture could determine hardness and tenderness of rice. Based on this study, texture averages of cooked rice were 25.70 to 33.00 gf (Fig. 1). The

analysis of variance showed that cooking method had significant effect on texture of cooked rice (Table 1), while variety of rice and interaction between cooking method and variety of rice had no significant effect on texture of cooked rice. The cooked rice that had high texture value was harder than cooked rice that had low texture value.

Color

Color analysis conducted on milled rice and cooked rice with attribute L (lightness), C (chroma) and H (hue). The maximum value of lightness was 100% that showed very white. The lightness value of Ciherang variety was 65.97%, while the lightness value of Ciliwung variety was 67.93% .

The lightness value of cooked rice with different varieties and cooking methods ranged from 73.07 to 76.20 % (Fig. 2). The highest lightness value (76.20 %) found in rice with A_2B_3 treatment (Ciliwung variety and cooking methods using the rice cooker), while the lowest lightness value (73.07 %) found in rice with A_1B_1 treatment (Ciherang variety and *liwet* methods). The high lightness value of rice indicated that the color of rice was brighter. The analysis of variance showed that cooking method had significant effect on lightness of cooked rice (Table 2), while variety of rice and interaction between cooking method and variety of rice had no significant effect on lightness of cooked rice.

The chroma value of Ciherang variety was 12.03%, while the chroma value of Ciliwung variety was 12.00%. The chroma value of cooked rice with different varieties and cooking methods ranged from 5.63 to 7.10% (Fig. 3). The highest chroma value (7.10 %) found in rice with A_1B_1 treatment (Ciherang variety and *liwet* method), while the lowest chroma value (5.63 %) found in rice with A_2B_3 treatment (Ciliwung varietiy and cooking method using the rice cooker). The analysis of variance showed that cooking method had significant effect on chroma of cooked rice (Table 3), while variety of rice and interaction between cooking method and variety of rice had no significant effect on chroma.

The hue value of Ciherang variety was 69.37^o, while the hue value of Ciliwung variety was 65.70^o. The hue value of parboiled rice with different varieties and cooking methods ranged from 62.43 to 68.20^o (Fig. 4). The highest hue value (68.20^o) found in rice with A_2B_3 treatment (Ciliwung variety and cooking method using the rice cooker), while the lowest hue value (62.43^o) found in rice with A_1B_1 treatment (Ciherang variety and *liwet* method). The analysis of variance showed that cooking method had significant effect on hue of cooked rice (Table 4), while variety of rice and interaction between cooking method and variety of rice had no significant effect on hue of cooked rice. According to hue value, Ciherang and Ciliwung varieties with different cooking method had yellow-red (YR) color.

Moisture Content

The moisture content was measured in milled rice and cooked rice. The moisture content averages of Ciherang variety was 12.27%, while the moisture content averages of Ciliwung variety was 12.22%. The moisture content of cooked rice with different varieties and cooking methods ranged from 56.01 to 57.68% (Fig. 5). The highest moisture content value (57.68%) found in rice with A_2B_1 treatment (Ciliwung variety and *liwet* method), while the lowest hue value (56.01%) found in rice with A_1B_2 treatment (Ciherang variety and combination of boiling and steaming method). The analysis of variance showed that cooking method had significant effect on moisture content of cooked rice (Table 5), while variety of rice and interaction between cooking method and variety of rice had no significant effect on moisture content of cooked rice.

Amylose Content

Amylose content measured in rice of Ciherang and Ciliwung varieties. Determination of amylose content begins with the manufacture of standard curve, where the resulting regression equation was y = 0,0217x - 0.0161. The average value of amylose content with treatment A_1 (Ciherang variety) was 22.64%, while the average value of amylose content with treatment A_2 (Ciliwung variety) was 18,85%.

Protein Content and Total Amino Acid

The result showed that protein content and total amino acids of Ciherang variety were 10.73% and 7.75% respectively, while protein content and total amino acids of Ciliwung variety were 8.98% and 6,98% respectively (Table 6). Total amino acids were observed consisting of 10 types of essential amino acids and 5 types of non-

essential amino acids. The most abundant amino acids contained in Ciherang and Ciliwung varieties namely glutamic acid (non-essential amino acids) of 1.68% and 1.49% respectively.

DISCUSSION

Dimention of rice included length, width, and ratio between length and width. The result showed that length of Ciherang and Ciliwung varieties including classification long grain rice. This was consistent with research Setyono and Wibowo (2008) which stated that a length of rice 6.6 to 7.5 mm classified as long grain rice. Based on the ratio between length and width, Ciherang and Ciliwung varieties including into long grain rice type and rice shape slender (ratio L/W $\geq$ 3,0) (Slaton et al, 2000 ; Setyono and Wibowo, 2008). The slender rice is more preferable by consumers.

Texture value indicated as hardness of cooked rice. The rice that cooked with *liwet* method had low texture value. It caused the texture of cooked rice was softer than the other methods. During cooking process with *liwet* method, rice absorb water and starch granules in rice will swell. Cooking process with *liwet* method performed heating temperature setting. The heating temperature setting included the big fire which used to speed up the process of heating water reaching the boiling point temperature of water (100 ^{o}C), moderate heat to ripen the rice, and a small fire to prevent the formation of a thick crust. Setting the heating temperature ranging from the boiling water and rice until the rice maturation. Setting the temperature during *liwet* methods caused heat exposure on rice longer than combination of boiling and steaming method and modern method using a rice cooker. Exposure to prolonged heat causes the texture of rice was softer. Cooking rice with combination of boiling and steaming method had the highest value of texture, so the rice produced had a harder texture than the rice produced using *liwet* method and modern method using the rice cooker. Cooking rice with combination of boiling and steaming method had the highest average value of texture because at the time after water boiled at 100 ^{o}C, the water absorbed into the rice and then the fire was turned off. Furthermore, the rice cooled and occured re-arrangement of amylose that leads to retrogradation process before entering the stage steaming, so the texture of rice produced was louder. According to Winarno (2004), retrogradation is a re-crystallization process of starch which has undergone gelatinization. One of the factors that affect the texture of rice is gelatinization process. Rice to become cooked rice must undergo gelatinization (Marshall, 1994). Gelatinization process occurs during the warm rice in water until it becomes cooked rice. Gelatinization temperature affect the ripening time. Rice that has a high gelatinization temperature need a longer cooking time than rice that has a low gelatinization temperature.

Color analysis conducted on milled rice and cooked rice with attribute L (lightness), C (chroma) and H (hue). Lightness value indicates the brightness or darkness of a color (Winarno, 2004). The high lightness value of rice indicated that the color of rice is brighter. Lightness value of cooked rice affected by temperature and cooking time for each cooking method. The rice cooked using *liwet* methods was the lowest. Cooking process with *liwet* method performed heating temperature setting manually, which caused heat exposure on rice longer than other methods. It caused the time of cooking rice was longer. The heating time on the rice will caused a browning reaction between carbohydrates and protein, and will produce darker rice (yellow-red). It indicated by low value of lightness. The rice cooked using rice cooker had the lowest value of chroma. The chroma values affected by temperature and cooking time for each cooking method. The process of cooking rice using a rice cooker required a shorter time than the other methods, so the heating process during cooking was faster. Accelerated warming process will minimize the risk of browning reaction (Maillard) on rice, so that rice produced had a weak color indicated by lower chroma values. Browning reaction (Maillard) will cause higher chroma values on rice. According to hue value, Ciherang and Ciliwung varieties with different cooking method had yellow-red (YR) color. Formation of colors on rice affected by heating process during cooking rice. During the heating process occurs reaction between the protein and reducing sugar. It cause the formation of glycocylamin. Glycocylamin suffered polymerase to form melanoidin which causes color changes of rice to yellow red (Maillard reaction) (Wahyudi, 2005).

The moisture content was measured in milled rice and cooked rice. Water is one of the important elements in food stuffs. According to Sudarmadji et al. (2007), the moisture content is the amount of water contained in food, included free water and water bound physically and chemically. According to Badan Standarisasi Nasional (1999), maximum moisture content is 14% of milled rice. The moisture content of Ciherang and Ciliwung varieties according to the moisture content determined by SNI 01-6128-1999. The results of moisture content analysis also showed that cooking rice with *liwet* method had the highest moisture content, so the texture rice softer than the other methods. It occured because rice longer exposure to heat. In addition, water trapped in the pan can be absorbed back into the rice during the resting time after the fire turned off, so it will affect the moisture content of the rice.

Amylose content is one of the important criteria in the classification system of rice. The amylose content of Ciherang variety including moderate classification, while the amylose content with of Ciliwung variety including low classification. According to Allidawati and Bambang (1989), based on the amylose level, rice grouped into very low of amylose (<10%), low (10 to 20%), moderate (20 to 24%) and high (> 25%). Higher amylose content in rice will increase the occurrence of rearrangement of amylose after experiencing gelatinisasi leading to retrogradation process. Rice that have high amylose will produce not sticky rice, can expand and become hard if it is cold. Moderate amylose rice have fluffier texture generally. Low amylose rice produce sticky rice, shiny, not expand, and still coagulate after a cold when cooked (Damardjati, 1995 in Indrasari et al., 2009).

The protein content of Ciherang and Ciliwung varieties were 10.73% and 8.98%, while total amino acids of Ciherang and Ciliwung varieties were 6,98% and 7.75% respectively. The most abundant amino acids contained in Ciherang and Ciliwung varieties namely glutamic acid (non-essential amino acids). According to the Nutrition Directorate of the Ministry of Health (1996), the protein content of rice per 100 grams is 7.6%. According to Haryadi et al. (2008) in Larasati (2012), protein content of rice is 7.3 to 10.2% and a maximum of 14%. According to Haryadi (2008), the rice contains higher protein needs more water and a longer cooking time. This relates to the structure of the seed. The starch granules enclosed in a protein, so the absorption of water blocked by protein. It causes the time of cooking is longer.

CONCLUSION

Ciherang variety had a length and width ratio of 3.44, lightness 65.97%, chroma 12.03%, hue 69,37^{o}, moisture content, amylose content 22.64%, protein content 10.73%, and total amino acids 7.75%. Ciliwung variety had a length and width ratio of 3.21, lightness 67.93%, chroma 12.00%, hue 65,70^{o}, moisture content 12.22%, amylose content 18.85%, protein content 8.98%, and total amino acids 6.98%. The method of cooking had significant effects on texture (hardness), color (lightness, chroma, hue), and moisture content of the cooked rice.

ACKNOWLEDGEMENTS

This research was supported by International Rice Research Institute (IRRI), and Research Center of Sub-Optimal Land (PUR-PLSO) Sriwijaya University.

REFERENCES

Allidawati and Bambang K. 1989. Quality Test Method of Rice in Rice Breeding Program. Center for Food Crops Research and Development, Bogor : 363-375.

AOAC. 2006. Official Methods od An Anlysis of Analysis Chemistry. Washington DC. United Stated of America.

Badan Standarisasi Nasional. 1999. Quality standards and test methods for milled rice (SNI 01-6128-1999). Jakarta.

Damardjati DS and Purwani EY. 1991. Quality of Rice. *Rice-Book 3*, 4 (4): 85-94.

Deliani L. 2004. Studying the Effect of Several Rice Varieties Storage with Different Levels of Sticky on Parboiling Quality. FATETA. IPB. Bogor.

Han SH, Lee SW dan Rhee C. 2008. Effects of cooking methods on starch hydrolysis kinetics and digestion-resistant fractions of rice and soybean. *Eur. J. Food Res. Technol*, 227 : 1315-1321.

Haryadi. 2008. Rice Processing Technology. Gadjah Mada University Press, Yogyakarta.

Indrasari SD, Purwani EY, Widowati S and Damardjati DS. 2009. The enhancement of value added of rice through physical quality, taste and nutrition. Rice Research Institute. Sukamandi.

Larasati SP. 2012. The properties of physicochemical and organoleptic characteristics of several rice varieties [Thesis]. Department of Community Nutrition, Faculty of Human Ecology, IPB. Bogor.

Marshall WE. 1994. Starch Gelatinization in Brown and Miled Rice : A Study Using Differential Scanning Calorimetry. In Rice Science and Technology (wyne E. Marshall and James I. Wadsworth, ed). P. 205-225. Agric. Res. Serv., USDA, New Orleans.

Munsell. 1997. Colour Chart For Plant Tissu Mecbelt Division Of Kalmorgen Instrument Corporation. Baltimore Maryland.

Nutrition Directorate of the Ministry of Health. 1996. List of Food Composition. Bhratara Commerce Media. Jakarta.

Putri AS. 2012. Physical, chemical and sensory characteristics of rice retrogradation [Thesis]. Study Program of Agricultural Technology. Department of Agricultural Technology. Faculty of Agriculture, University of Sriwijaya. Indralaya.

Setyono A and Wibowo P. 2008. Selection of quality rice relationship with the characteristics of several strains of inbred and hybrid rice. *Seminar Nasional Padi* : 1525-1534.

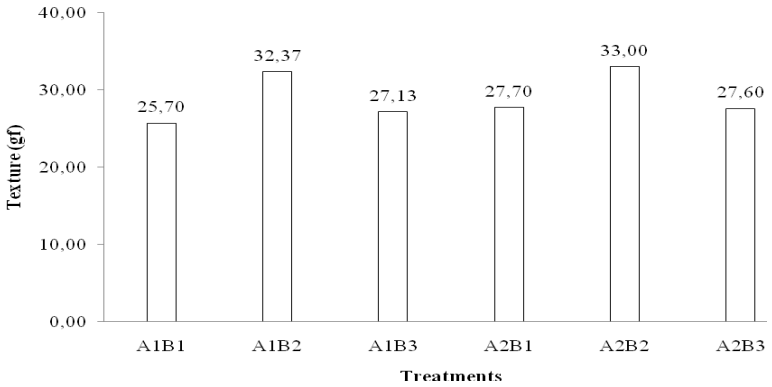
Slaton N, Blocker M, Wilson C, Dilday R, Robinson J dan Koen B. 2000. Grain Characteristics of rice varieties. University of Arkansas Division of Agriculture, US. Department of Agriculture and County Govemments Cooperating, US.

Sudana W. 2005. Potential and prospect of wetlands as a source of agricultural production. *Analisis Kebijakan Pertanian*, 3 (2) : 141-151.

Sudarmadji S, B Haryono dan Suhardi. 1997. Analysis procedures for Foodstuff and Agriculture. Penerbit Liberty. Yogyakarta.

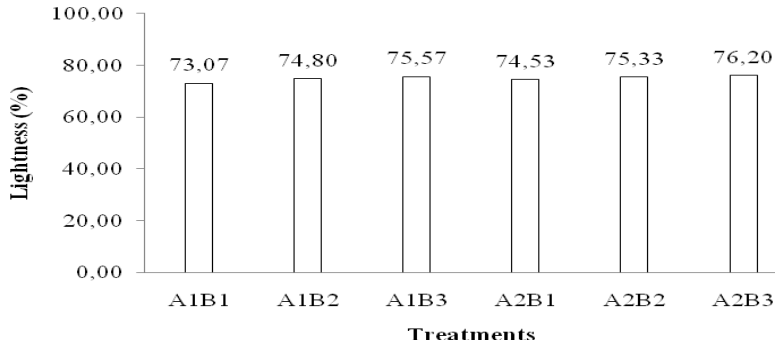
Sutarjana J. 2009. Heritage Culinary Mistress of the House : 1200 Legendary Recipes and Snacks. Gramedia Pustaka Utama. Jakarta.

Syafutri MI. 2015. Characteristics of swamp rice in South Sumatera, Indonesia [Research Report]. Sriwijaya University. Indralaya.
Wahyudi T. 2005. Assessment of Physical, Chemical and Organoleptic Quality of Rice with Several Rice Varieties [Thesis]. Department of Agricultural Technology Faculty of Agriculture, University of Sriwijaya. Indralaya.
Winarno FG. 2004. Food Chemistry and Nutrition. PT. Gramedia Pustaka Utama. Jakarta.
Yadav RB, Khatkar BS dan Yadav BS. 2007. Morphological, physico chemical and cooking properties of some Indian rice (Oryza sativa L.) Cultivars. *J. Agric. Technol.*, 3 (2) : 203-210.



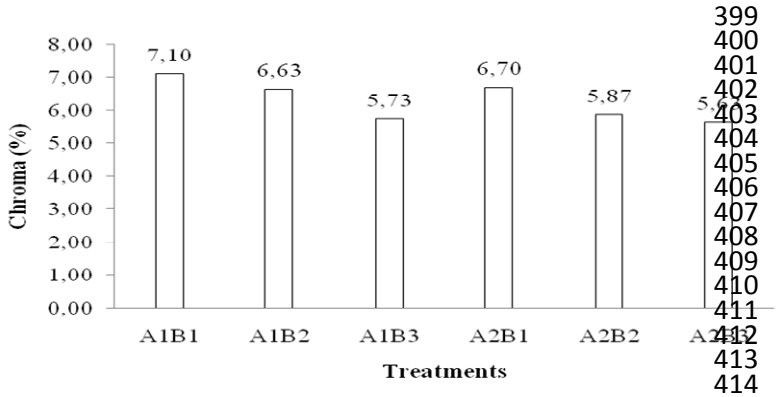
A_1 = Ciherang
A_2 = Ciliwung
B_1 = *liwet* (traditional method)
B_2 = combination of *pengaronan* (boiling) and steaming
B_3 = using rice cooker

Fig. 1. Texture average of cooked rice with difference of cooking methods



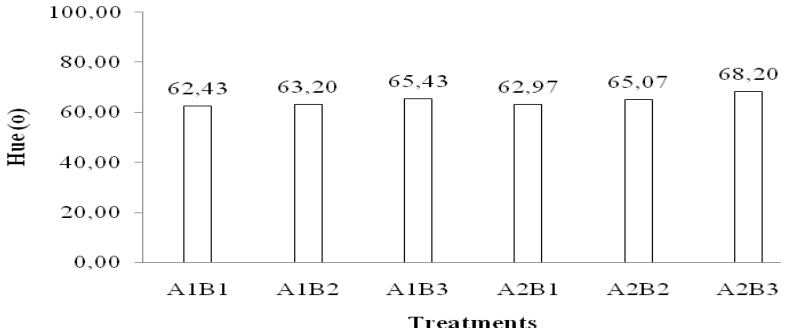
A_1 = Ciherang
A_2 = Ciliwung
B_1 = *liwet* (traditional method)
B_2 = combination of *pengaronan* (boiling) and steaming
B_3 = using rice cooker

Fig. 2. Lightness average of cooked rice with difference of cooking methods



A_1 = Ciherang
A_2 = Ciliwung
B_1 = *liwet* (traditional method)
B_2 = combination of *pengaronan* (boiling) and steaming
B_3 = using rice cooker

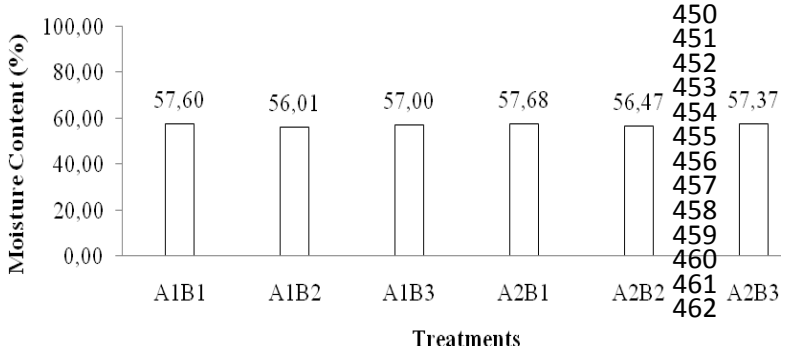
Fig. 3. Chroma average of cooked rice with difference of cooking methods



A_1 = Ciherang
A_2 = Ciliwung

B_1 = *liwet* (traditional method)
B_2 = combination of *pengaronan* (boiling) and steaming
B_3 = using rice cooker

Fig. 4. Hue average of cooked rice with difference of cooking methods



A_1 = Ciherang
A_2 = Ciliwung

B_1 = *liwet* (traditional method)
B_2 = combination of *pengaronan* (boiling) and steaming
B_3 = using rice cooker

Fig. 5. Moisture content average of cooked rice with difference of cooking methods

Table 1. HSD test of cooking method influence on texture of cooked rice

Cooking Methods	Texture Averages (gf)	HSD 5% = 0.58
B_1 (*liwet* (traditional method))	26.70	a
B_3 (using rice cooker)	27.37	b
B_2 (combination of *pengaronan* (boiling) and steaming)	32.68	c

Table 2. HSD test of cooking method influence on lightness of cooked rice

Cooking Methods	Lightness Averages (%)	HSD 5% = 0.58
B_1 (*liwet* (traditional method))	73.80	a
B_2 (combination of *pengaronan* (boiling) and steaming)	75.07	b
B_3 (using rice cooker)	75.88	c

Table 3. HSD test of cooking method influence on chroma of cooked rice

Cooking Methods	Chroma Averages (%)	HSD 5% = 0.21
B_3 (using rice cooker)	5.68	a
B_2 (combination of *pengaronan* (boiling) and steaming)	6.25	b
B_1 (*liwet* (traditional method))	6.90	c

Table 4. HSD test of cooking method influence on hue of cooked rice

Cooking Methods	Hue Averages (°)	HSD 5% = 1.00
B_1 (*liwet* (traditional method))	62.70	a
B_2 (combination of *pengaronan* (boiling) and steaming)	64.13	b
B_3 (using rice cooker)	66.82	c

Table 5. HSD test of cooking method influence on moisture content of cooked rice

Cooking Methods	Moisture Content Averages (%)	HSD 5% = 0.16
B_2 (combination of *pengaronan* (boiling) and steaming)	56.24	a
B_3 (using rice cooker)	57.18	b
B_1 (*liwet* (traditional method))	57.64	c

Table 6. Protein content and total amino acids of Ciherang and Ciliwung varieties

Parameter	Result		Unit
	Ciherang	Ciliwung	
Protein Content	10,73	8,98	%w/w
Amino Acid			
Aspartic acid	0,79	0,69	% w/w
Glutamic acid	1,68	1,49	% w/w
Serine	0,47	0,43	% w/w
Histidine	0,21	0,19	% w/w
Glycine	0,36	0,34	% w/w
Threonine	0,29	0,27	% w/w
Arginine	0,69	0,59	% w/w
Alanine	0,47	0,43	% w/w
Tyrosine	0,30	0,26	% w/w
Methionine	0,13	0,14	% w/w
Valine	0,49	0,44	% w/w
Phenylalanine	0,49	0,44	% w/w
I-leucine	0,37	0,34	% w/w
Leucine	0,72	0,64	% w/w
Lysine	0,29	0,30	% w/w
Amino Acid Total	7,75	6,98	% w/w

The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods

Abstract : The objective of the research was to analyze the effect of different lowland rice varieties and different cooking methods on physical and **chemical properties** of cooked rice. The research used a factorial Randomized Block Design with two factors and each combination of the factors was repeated three times. The first factor was rice variety (A_1: Ciherang variety, A_2: Ciliwung variety) and the second factor was the cooking method (B_1: stovetop, B_2: boiled and steamed, B_3: rice cooker). Milled rice of Ciherang variety had the ratio between length and width was 3.44, lightness of 65.97%, chroma of 12.03%, hue of 69.37^o, moisture content of 12.27%, amylose content of 22.64%, protein content of 10.73%, total amino acid of 7.75%. Milled rice of Ciliwung variety had the ratio between length and width was 3.21, lightness of 67.93%, chroma of 12.00%, hue of 65.70^o, moisture content of 12.22%, amylose content of 18.85%, protein content of 8.98%, total amino acid of 6.98%. Results showed that the lightness of cooked rice was in the range of 73.07% to 76.20%, chroma of 5.63% to 7.10%, hue of 62.43^o to 68.20^o and texture of 25.70 gf to 33.00 gf. Statistical analysis showed that cooking method had significant effects on texture, lightness, chroma, hue and moisture content of cooked rice.
Key words : cooking method; cooked rice; lowland rice varieties

Rice is one of the important commodity results in rice farming systems in lowland swamp. Lowland swamp land that has been cultivated for rice farming with cropping patterns once a year is 91%, while for rice farming with cropping twice a year only about 9% (Sudana, 2005). The varieties of rice grown in lowland swamp area consists of various varieties namely Ciherang, Ciliwung, Mekongga, IR 10, IR 42, IR 64, Ciherang Dempo, Ciliwung Jumbo, and Rojo Lele (Syafutri, 2015). Ciherang and Ciliwung are several varieties widely grown by farmers in lowland swamp land. The difference of rice varieties will affect the characteristics of cooked rice produced. According to Yadav et al (2007), different rice varieties showed significant effects on the physicochemical properties, morphology, and cooking properties, but Putri (2012) stated that the starch contents of rice were still the same ie more than 80%. Cooking method also affect the characteristics of cooked rice. According to Han et al (2008), different cooking method will affect the hydrolysis of starch rice. Cooking the raw rice into the cooked rice can be done in various ways. Indonesian people use two ways to cook rice namely conventional and modern way. The conventional way consist of *liwet* method using stovetop, and combination of boiling and steaming method. The modern way was cooking rice using electric rice cooker. Each cooking method uses different heat and long cooking. The objective of this study was to analyze the effect of different lowland rice varieties and different cooking methods on physical and chemical of cooked rice.

MATERIALS AND METHODS

Rice Materials

The rice used in this study derived from lowland swamp land at East OKU, South Sumatera, Indonesia. The varieties of rice were Ciherang and Ciliwung.

Methods

This study using Factorial Randomized Block Design with two treatment factors and repeated three times. The treatment factors were rice variety (A) and the cooking method (B). The first factor consisted of two levels : Ciherang (A_1) and Ciliwung (A_2), where as the second factor consisted of three levels : *liwet* method using stovetop (B_1), combination of boiled and steamed (B_2), and rice cooker (B_3). The data obtained performed using analysis of variance (ANOVA) 5% and HSD test. The parameters of this study were physical and chemical characteristics on milled rice and cooked rice. The physical characteristics of milled rice included dimensions rice and color, where as the chemical characteristics of milled rice included moisture content, amylose content, protein content and total amino acids. The physical characteristics of cooked rice were color and texture, while the chemical characteristic was moisture content.

Liwet Method using Stovetop

The procedurs of *liwet* method (Deliani, 2004) which has been modified were : first, milled rice with whole grains (100 g) cleared from foreign objects and dirt. Second, rice washed with clean water (2 times) and drained

for 2 minutes, then put in a regular pot or pan pot. Next step, water (150 mL) was added to the pot containing. Fourth, the rice cooked in a covered pot until boiling. Then, stirring done 10 times after boiling water (100°C). Sixth, if the water was up, stirred again (stirring the latter performed 5 times and the pot sealed while the fire diminished. Last, the cooking times of *liwet* method were 10 minutes.

Combination of Boiled and Steamed Method

The procedurs of boiled and steamed combination method (Deliani, 2004) which has been modified were : first, milled rice with whole grains (100 g) cleared from foreign objects and dirt. Second, rice washed with clean water (2 times) and drained for 2 minutes, then put in a regular pot or pan pot. Third, water (150 mL) was added to the pot containing. Next, the rice cooked in a covered pot to a boil for 5 minutes, then reduce the heat (during heating stirring 15 times until becoming rice (water absorbed by rice). Fifth, stirring done 10 times after boiling water (100°C) to become rice (water absorbed by rice). Then, rice stirred and moved to the steamer containing boiled water, then waited for 5 minutes.

Rice Cooker Method

The procedurs of modern cooking method (rice cooker) (Sutarjana, 2009) which has been modified were : first, milled rice with whole grains (100 g) cleared from foreign objects and dirt. Second, rice washed with clean water (2 times) and drained for 2 minutes and put in an aluminum pan on the rice cooker. Then, water (150 mL) was added. Fourth, thermostat clicked and light "cooking" light up on the rice cooker to cook the raw rice into the cooked rice. Finally, the thermostat button will automatically moved from the position of the light "cooking" to the position of the lights "warmer" that shows rice cooked.

Dimention of rice

Rice dimensions include length and width measured using calipers. Whole rice intact (10 seeds) taken from each variety. Seeds of rice measured length and width using calipers and the average was taken.

Texture

Texture of rice was measured with "Brookfield" texture analyzer (Faridah et al, 2006). Brook (cylindrical type) mounted just above the sample. The needle was attached to the tip of the sample. Brooke (blade type) pressing right in the middle of the sample. Then, on display listed number of peak load and final load (gram force).

Color

Analysis of color was measured using "Konica Minolta" Chromameter. Chromameter turned on and the button was activated to select and determine the values and numbers were used. The values that be used were Lightness (L), Chroma (C) and Hue (H). Samples of rice were placed under the lens of Chromameter and numbers of L (%), C (%), and H (^{o}) will be shown (Munsell, 1997).

Chemical Characteristics

The chemical characteristics included moisture content, amylose content, protein content and total amino acids. Moisture content, amylose content, protein content and total amino acids were determined using method of AOAC (2006).

RESULTS

Dimention of Rice

Variety of lowland swamp rice used for this study were Ciherang and Ciliwung. Dimention averages of Ciherang and Ciliwung varieties included length and width. Rice of Ciherang variety had **length of** 7.01 mm and **width of** 2.04 mm. Rice of Ciliwung variety had length of 6.75 mm and width of 2.10 mm. The ratio between length and width of Ciherang variety was 3.44, while the ratio between length and width of Ciliwung variety ratio was 3.21.

Texture

Texture indicated as hardness of rice that cooked with some cooking methods. Physically, hardness of rice defined as rice ability to accept certein load in certain time. **Analysis** of texture could determine hardness and

tenderness of rice. Based on this study, texture averages of cooked rice were 25.70 to 33.00 gf (Fig. 1). The analysis of variance showed that cooking method had significant effect on texture of cooked rice (Table 1), while variety of rice and interaction between cooking method and variety of rice had no significant effect on texture of cooked rice. The cooked rice that had high texture value was harder than cooked rice that had low texture value.

Color

Color analysis conducted on milled rice and cooked rice with attribute L (lightness), C (chroma) and H (hue). The maximum value of lightness was 100% that showed very white. The lightness value of Ciherang variety was 65.97%, while the lightness value of Ciliwung variety was 67.93% .

The lightness value of cooked rice with different varieties and cooking methods ranged from 73.07 to 76.20 % (Fig. 2). The highest lightness value (76.20 %) found in rice with A_2B_3 treatment (Ciliwung variety and cooking methods using the rice cooker), while the lowest lightness value (73.07 %) found in rice with A_1B_1 treatment (Ciherang variety and *liwet* methods). The high lightness value of rice indicated that the color of rice was brighter. The analysis of variance showed that cooking method had significant effect on lightness of cooked rice (Table 2), while variety of rice and interaction between cooking method and variety of rice had no significant effect on lightness of cooked rice.

The chroma value of Ciherang variety was 12.03%, while the chroma value of Ciliwung variety was 12.00%. The chroma value of cooked rice with different varieties and cooking methods ranged from 5.63 to 7.10% (Fig. 3). The highest chroma value (7.10 %) found in rice with A_1B_1 treatment (Ciherang variety and *liwet* method), while the lowest chroma value (5.63 %) found in rice with A_2B_3 treatment (Ciliwung varietiy and cooking method using the rice cooker). The analysis of variance showed that cooking method had significant effect on chroma of cooked rice (Table 3), while variety of rice and interaction between cooking method and variety of rice had no significant effect on chroma.

The hue value of Ciherang variety was 69.37^o, while the hue value of Ciliwung variety was 65.70^o. The hue value of parboiled rice with different varieties and cooking methods ranged from 62.43 to 68.20^o (Fig. 4). The highest hue value (68.20^o) found in rice with A_2B_3 treatment (Ciliwung variety and cooking method using the rice cooker), while the lowest hue value (62.43^o) found in rice with A_1B_1 treatment (Ciherang variety and *liwet* method). The analysis of variance showed that cooking method had significant effect on hue of cooked rice (Table 4), while variety of rice and interaction between cooking method and variety of rice had no significant effect on hue of cooked rice. According to hue value, Ciherang and Ciliwung varieties with different cooking method had yellow-red (YR) color.

Moisture Content

The moisture content was measured in milled rice and cooked rice. The moisture content averages of Ciherang variety was 12.27%, while the moisture content averages of Ciliwung variety was 12.22%. The moisture content of cooked rice with different varieties and cooking methods ranged from 56.01 to 57.68% (Fig. 5). The highest moisture content value (57.68%) found in rice with A_2B_1 treatment (Ciliwung variety and *liwet* method), while the lowest hue value (56.01%) found in rice with A_1B_2 treatment (Ciherang variety and combination of boiling and steaming method). The analysis of variance showed that cooking method had significant effect on moisture content of cooked rice (Table 5), while variety of rice and interaction between cooking method and variety of rice had no significant effect on moisture content of cooked rice.

Amylose Content

Amylose content measured in rice of Ciherang and Ciliwung varieties. Determination of amylose content begins with the manufacture of standard curve, where the resulting regression equation was y = 0,0217x - 0.0161. The average value of amylose content with treatment A_1 (Ciherang variety) was 22.64%, while the average value of amylose content with treatment A_2 (Ciliwung variety) was 18.85%.

Protein Content and Total Amino Acid

The result showed that protein content and total amino acids of Ciherang variety were 10.73% and 7.75% respectively, while protein content and total amino acids of Ciliwung variety were 8.98% and 6,98% respectively (Table 6). Total amino acids were observed consisting of 10 types of essential amino acids and 5 types of non-

essential amino acids. The most abundant amino acids contained in Ciherang and Ciliwung varieties namely glutamic acid (non-essential amino acids) of 1.68% and 1.49% respectively.

DISCUSSION

Dimention of rice included length, width, and ratio between length and width. The result showed that length of Ciherang and Ciliwung varieties including classification long grain rice. This was consistent with research of Setyono and Wibowo (2008) which stated that a length of rice 6.6 to 7.5 mm classified as long grain rice. Based on the ratio between length and width, Ciherang and Ciliwung varieties including into long grain rice type and rice shape slender (ratio L/W $\geq$ 3,0) (Slaton et al, 2000 ; Setyono and Wibowo, 2008). The slender rice is more preferable by consumers.

Texture value indicated as hardness of cooked rice. **The result of this study showed that cooking method had significant effect on texture of cooked rice. Kim et al. (1987) and Daomukda et al. (2011) stated that cooking methods affected texture of rice**. The rice that cooked with *liwet* method had low texture value. It caused the texture of cooked rice was softer than the other methods. During cooking process with *liwet* method, rice absorb water and starch granules in rice will swell. Cooking process with *liwet* method performed heating temperature setting. The heating temperature setting included the big fire which used to speed up the process of heating water reaching the boiling point temperature of water (100 ^{o}C), moderate heat to ripen the rice, and a small fire to prevent the formation of a thick crust. Setting the heating temperature ranging from the boiling water and rice until the rice maturation. Setting the temperature during *liwet* methods caused heat exposure on rice longer than combination of boiling and steaming method and modern method using a rice cooker. Exposure to prolonged heat causes the texture of rice was softer. **This was consistent with research of Kim et al. (1987) which stated that cooking method of rice with soaking in boiling water had less hard and more cohesive texture than electric cooking.** Cooking rice with combination of boiling and steaming method had the highest value of texture, so the rice produced had a harder texture than the rice produced using *liwet* method and modern method using the rice cooker. Cooking rice with combination of boiling and steaming method had the highest average value of texture because at the time after water boiled at 100 ^{o}C, the water absorbed into the rice and then the fire was turned off. Furthermore, the rice cooled and occured re-arrangement of amylose that leads to retrogradation process before entering the stage steaming, so the texture of rice produced was louder. According to Winarno (2004), retrogradation is a re-crystallization process of starch which has undergone gelatinization. One of the factors that affect the texture of rice is gelatinization process. Rice to become cooked rice must undergo gelatinization (Marshall, 1994). Gelatinization process occurs during the warm rice in water until it becomes cooked rice. Gelatinization temperature affect the ripening time. Rice that has a high gelatinization temperature need a longer cooking time than rice that has a low gelatinization temperature.

Color analysis conducted on milled rice and cooked rice with attribute L (lightness), C (chroma) and H (hue). Lightness value indicates the brightness or darkness of a color (Winarno, 2004). The high lightness value of rice indicated that the color of rice was brighter. Lightness value of cooked rice affected by temperature and cooking time for each cooking method. The rice cooked using *liwet* methods was the lowest. Cooking process with *liwet* method performed heating temperature setting manually, which caused heat exposure on rice longer than other methods. It caused the time of cooking rice was longer. The heating time on the rice will caused a browning reaction between carbohydrates and protein, and will produce darker rice (yellow-red). It indicated by low value of lightness. The rice cooked using rice cooker had the lowest value of chroma. The chroma values affected by temperature and cooking time for each cooking method. The process of cooking rice using a rice cooker required a shorter time than the other methods, so the heating process during cooking was faster. Accelerated warming process will minimize the risk of browning reaction (Maillard) on rice, so that rice produced had a weak color indicated by lower chroma values. Browning reaction (Maillard) will cause higher chroma values on rice. According to hue value, Ciherang and Ciliwung varieties with different cooking method had yellow-red (YR) color. Formation of colors on rice affected by heating process during cooking rice. During the heating process occurs reaction between the protein and reducing sugar. It cause the formation of glycocylamin. Glycocylamin suffered polymerase to form melanoidin which causes color changes of rice to yellow red (Maillard reaction) (Wahyudi, 2005).

The moisture content was measured in milled rice and cooked rice. Water is one of the important elements in food stuffs. According to Sudarmadji et al. (2007), the moisture content is the amount of water contained in food, included free water and water bound physically and chemically. According to Badan Standarisasi Nasional (1999), maximum moisture content is 14% of milled rice. The moisture content of Ciherang and Ciliwung varieties according to the moisture content determined by SNI 01-6128-1999. The result of moisture content

analysis also showed that cooking rice with *liwet* method had the highest moisture content, so the texture rice softer than the other methods. It occured because rice longer exposure to heat. In addition, water trapped in the pan can be absorbed back into the rice during the resting time after the fire turned off, so it will affect the moisture content of the rice. **The result also showed that the moisture content of rice that cooked with rice cooker was higher than rice that cooked with boiling and steaming combination. This was consistent with research of Daomukda et al. (2011) which stated that the moisture content of brown rice that cooked with electric cook method was higher than steaming method.**

Amylose content is one of the important criteria in the classification system of rice. The amylose content of Ciherang variety including moderate classification, while the amylose content with of Ciliwung variety including low classification. According to Allidawati and Bambang (1989), based on the amylose level, rice grouped into very low of amylose (<10%), low (10 to 20%), moderate (20 to 24%) and high (> 25%). Higher amylose content in rice will increase the occurrence of rearrangement of amylose after experiencing gelatinisasi leading to retrogradation process. Rice that have high amylose will produce not sticky rice, can expand and become hard if it is cold. Moderate amylose rice have fluffier texture generally. Low amylose rice produce sticky rice, shiny, not expand, and still coagulate after a cold when cooked (Damardjati, 1995 in Indrasari et al., 2009).

The protein content of Ciherang and Ciliwung varieties were 10.73% and 8.98%, while total amino acids of Ciherang and Ciliwung varieties were 6,98% and 7.75% respectively. The most abundant amino acids contained in Ciherang and Ciliwung varieties namely glutamic acid (non-essential amino acids). According to the Nutrition Directorate of the Ministry of Health (1996), the protein content of rice per 100 grams is 7.6%. According to Haryadi et al. (2008) in Larasati (2012), protein content of rice is 7.3 to 10.2% and a maximum of 14%. According to Haryadi (2008), the rice contains higher protein needs more water and a longer cooking time. This relates to the structure of the seed. The starch granules enclosed in a protein, so the absorption of water blocked by protein. It causes the time of cooking is longer.

CONCLUSION

Ciherang variety had a length and width ratio of 3.44, lightness of 65.97%, chroma of 12.03%, hue of 69,37^{o}, moisture content of 12.27%, amylose content of 22.64%, protein content of 10.73%, and total amino acids of 7.75%. Ciliwung variety had a length and width ratio of 3.21, lightness of 67.93%, chroma of 12.00%, hue of 65,70^{o}, moisture content of 12.22%, amylose content of 18.85%, protein content of 8.98%, and total amino acids of 6.98%. The method of cooking had significant effects on texture (hardness), color (lightness, chroma, hue), and moisture content of the cooked rice.

ACKNOWLEDGEMENTS

This research was supported by International Rice Research Institute (IRRI), and Research Center of Sub-Optimal Land (PUR-PLSO) Sriwijaya University.

REFERENCES

Allidawati and Bambang K. 1989. Quality Test Method of Rice in Rice Breeding Program. Center for Food Crops Research and Development, Bogor : 363-375.

AOAC. 2006. Official Methods od An Anlysis of Analysis Chemistry. Washington DC. United Stated of America.

Badan Standarisasi Nasional. 1999. Quality standards and test methods for milled rice (SNI 01-6128-1999). Jakarta.

Damardjati DS and Purwani EY. 1991. Quality of Rice. *Rice-Book 3*, 4 (4): 85-94.

Daomukda N, Moongngam A, Payakapol L and Noisuwan A. 2011. Effect of cooking methods on physicochemical properties of brown rice. *2nd International Conference on Environmental Science and Technology*, 6 : VI-1-VI-4. Singapore.

Deliani L. 2004. Studying the Effect of Several Rice Varieties Storage with Different Levels of Sticky on Parboiling Quality. FATETA. IPB. Bogor.

Han SH, Lee SW and Rhee C. 2008. Effects of cooking methods on starch hydrolysis kinetics and digestion-resistant fractions of rice and soybean. *Eur. J. Food Res. Technol.*, 227 : 1315-1321.

Haryadi. 2008. Rice Processing Technology. Gadjah Mada University Press, Yogyakarta.

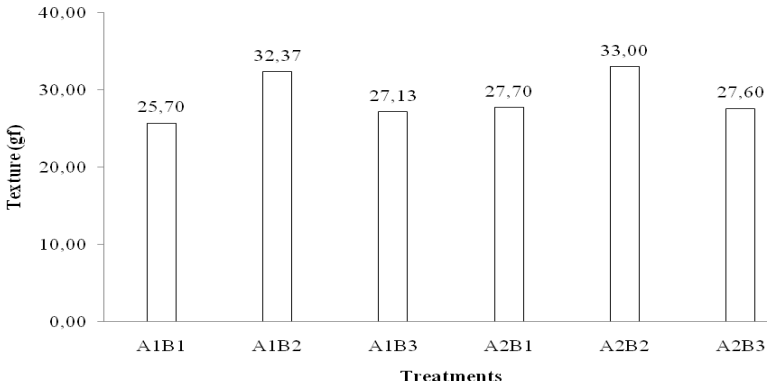
Indrasari SD, Purwani EY, Widowati S and Damardjati DS. 2009. The enhancement of value added of rice through physical quality, taste and nutrition. Rice Research Institute. Sukamandi.

Kim JS, Lee HY, Kim YM and Shin DH. 1987. Effect of cooking methods on qualities of quick cooking rice. *Korean J. Food Sci. Technol.*, 19 (6) : 480-485.

Larasati SP. 2012. The properties of physicochemical and organoleptic characteristics of several rice varieties [Thesis]. Department of Community Nutrition, Faculty of Human Ecology, IPB. Bogor.

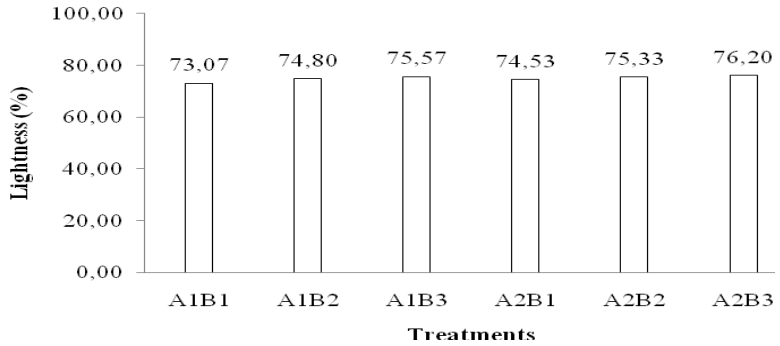
Marshall WE. 1994. Starch Gelatinization in Brown and Miled Rice : A Study Using Differential Scanning Calorimetry. In Rice Science and Technology (wyne E. Marshall and James I. Wadsworth, ed). P. 205-225. Agric. Res. Serv., USDA, New Orleans.

Munsell. 1997. Colour Chart For Plant Tissu Mecbelt Division Of Kalmorgen Instrument Corporation. Baltimore Maryland.
Nutrition Directorate of the Ministry of Health. 1996. List of Food Composition. Bhratara Commerce Media. Jakarta.
Putri AS. 2012. Physical, chemical and sensory characteristics of rice retrogradation [Thesis]. Study Program of Agricultural Technology. Department of Agricultural Technology. Faculty of Agriculture, University of Sriwijaya. Indralaya.
Setyono A and Wibowo P. 2008. Selection of quality rice relationship with the characteristics of several strains of inbred and hybrid rice. *Seminar Nasional Padi* : 1525-1534.
Slaton N, Blocker M, Wilson C, Dilday R, Robinson J dan Koen B. 2000. Grain Characteristics of rice varieties. University of Arkansas Division of Agriculture, US. Department of Agriculture and County Govemments Cooperating, US.
Sudana W. 2005. Potential and prospect of wetlands as a source of agricultural production. *Analisis Kebijakan Pertanian*, 3 (2) : 141-151.
Sudarmadji S, B Haryono dan Suhardi. 1997. Analysis procedures for Foodstuff and Agriculture. Penerbit Liberty. Yogyakarta.
Sutarjana J. 2009. Heritage Culinary Mistress of the House : 1200 Legendary Recipes and Snacks. Gramedia Pustaka Utama. Jakarta.
Syafutri MI. 2015. Characteristics of swamp rice in South Sumatera, Indonesia [Research Report]. Sriwijaya University. Indralaya.
Wahyudi T. 2005. Assessment of Physical, Chemical and Organoleptic Quality of Rice with Several Rice Varieties [Thesis]. Department of Agricultural Technology Faculty of Agriculture, University of Sriwijaya. Indralaya.
Winarno FG. 2004. Food Chemistry and Nutrition. PT. Gramedia Pustaka Utama. Jakarta.
Yadav RB, Khatkar BS dan Yadav BS. 2007. Morphological, physico chemical and cooking properties of some Indian rice (Oryza sativa L.) Cultivars. *J. Agric. Technol.*, 3 (2) : 203-210.



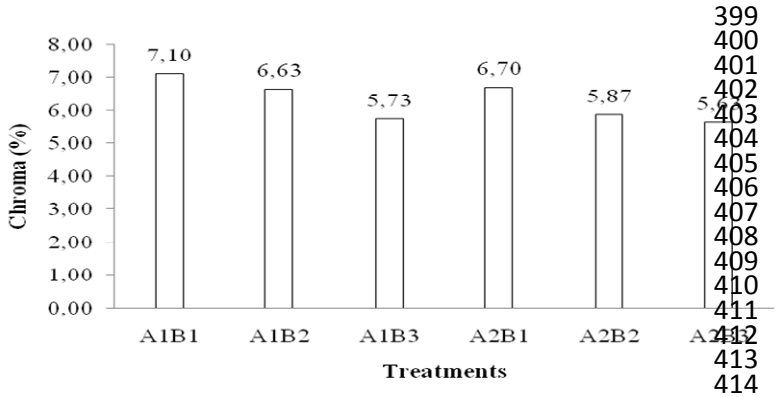
A_1 = Ciherang
A_2 = Ciliwung
B_1 = *liwet* (traditional method)
B_2 = combination of *pengaronan* (boiling) and steaming
B_3 = using rice cooker

Fig. 1. Texture average of cooked rice with difference of cooking methods



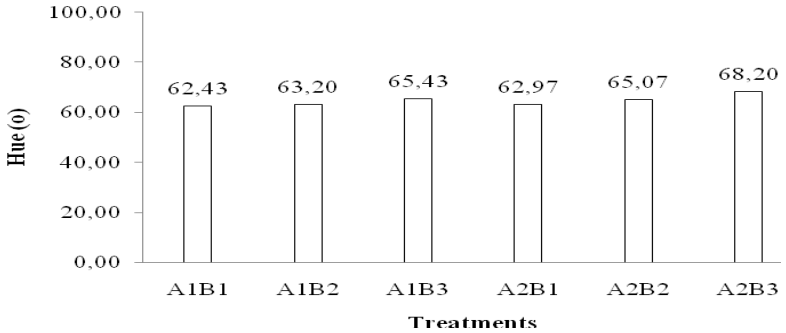
A_1 = Ciherang
A_2 = Ciliwung
B_1 = *liwet* (traditional method)
B_2 = combination of *pengaronan* (boiling) and steaming
B_3 = using rice cooker

Fig. 2. Lightness average of cooked rice with difference of cooking methods



A_1 = Ciherang
A_2 = Ciliwung
B_1 = *liwet* (traditional method)
B_2 = combination of *pengaronan* (boiling) and steaming
B_3 = using rice cooker

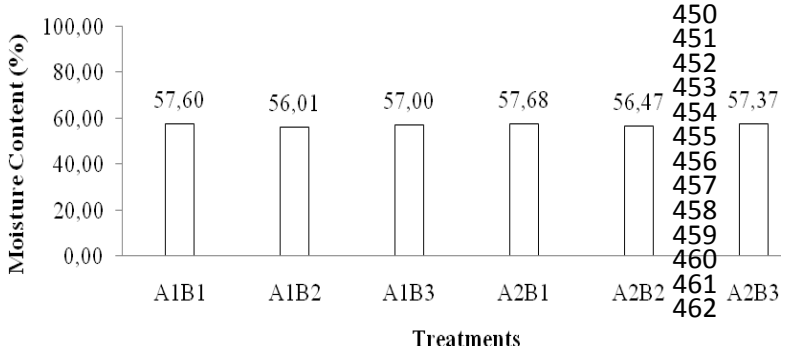
Fig. 3. Chroma average of cooked rice with difference of cooking methods



A_1 = Ciherang
A_2 = Ciliwung

B_1 = *liwet* (traditional method)
B_2 = combination of *pengaronan* (boiling) and steaming
B_3 = using rice cooker

Fig. 4. Hue average of cooked rice with difference of cooking methods



A_1 = Ciherang
A_2 = Ciliwung

B_1 = *liwet* (traditional method)
B_2 = combination of *pengaronan* (boiling) and steaming
B_3 = using rice cooker

Fig. 5. Moisture content average of cooked rice with difference of cooking methods

Table 1. HSD test of cooking method influence on texture of cooked rice

Cooking Methods	Texture Averages (gf)	HSD 5% = 0.58
B_1 (*liwet* (traditional method))	**26.70**	**a**
B_3 (using rice cooker)	**27.37**	**b**
B_2 (combination of *pengaronan* (boiling) and steaming)	**32.68**	**c**

Table 2. HSD test of cooking method influence on lightness of cooked rice

Cooking Methods	Lightness Averages (%)	HSD 5% = 0.58
B_1 (*liwet* (traditional method))	**73.80**	**a**
B_2 (combination of *pengaronan* (boiling) and steaming)	**75.07**	**b**
B_3 (using rice cooker)	**75.88**	**c**

Table 3. HSD test of cooking method influence on chroma of cooked rice

Cooking Methods	Chroma Averages (%)	HSD 5% = 0.21
B_3 (using rice cooker)	**5.68**	**a**
B_2 (combination of *pengaronan* (boiling) and steaming)	**6.25**	**b**
B_1 (*liwet* (traditional method))	**6.90**	**c**

Table 4. HSD test of cooking method influence on hue of cooked rice

Cooking Methods	Hue Averages (^{o})	HSD 5% = 1.00
B_1 (*liwet* (traditional method))	**62.70**	**a**
B_2 (combination of *pengaronan* (boiling) and steaming)	**64.13**	**b**
B_3 (using rice cooker)	**66.82**	**c**

Table 5. HSD test of cooking method influence on moisture content of cooked rice

Cooking Methods	Moisture Content Averages (%)	HSD 5% = 0.16
B_2 (combination of *pengaronan* (boiling) and steaming)	**56.24**	**a**
B_3 (using rice cooker)	**57.18**	**b**
B_1 (*liwet* (traditional method))	**57.64**	**c**

Table 6. Protein content and total amino acids of Ciherang and Ciliwung varieties

Parameter	Result		Unit
	Ciherang	Ciliwung	
Protein Content	10,73	8,98	%w/w
Amino Acid			
Aspartic acid	0,79	0,69	% w/w
Glutamic acid	1,68	1,49	% w/w
Serine	0,47	0,43	% w/w
Histidine	0,21	0,19	% w/w
Glycine	0,36	0,34	% w/w
Threonine	0,29	0,27	% w/w
Arginine	0,69	0,59	% w/w
Alanine	0,47	0,43	% w/w
Tyrosine	0,30	0,26	% w/w
Methionine	0,13	0,14	% w/w
Valine	0,49	0,44	% w/w
Phenylalanine	0,49	0,44	% w/w
I-leucine	0,37	0,34	% w/w
Leucine	0,72	0,64	% w/w
Lysine	0,29	0,30	% w/w
Amino Acid Total	7,75	6,98	% w/w

The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods

Abstract : The objective of the research was to analyze the effect of different lowland rice varieties and different cooking methods on physical and chemical properties of cooked rice. The research used a factorial Randomized Block Design with two factors and each combination of the factors was repeated three times. The first factor was rice variety (A_1: Ciherang variety, A_2: Ciliwung variety) and the second factor was the cooking method (B_1: stovetop, B_2: boiled and steamed, B_3: rice cooker). Milled rice of Ciherang variety had the ratio between length and width was 3.44, lightness of 65.97%, chroma of 12.03%, hue of 69.37^o, moisture content of 12.27%, amylose content of 22.64%, protein content of 10.73%, total amino acid of 7.75%. Milled rice of Ciliwung variety had the ratio between length and width was 3.21, lightness of 67.93%, chroma of 12.00%, hue of 65.70^o, moisture content of 12.22%, amylose content of 18.85%, protein content of 8.98%, total amino acid of 6.98%. Results showed that the lightness of cooked rice was in the range of 73.07% to 76.20%, chroma of 5.63% to 7.10%, hue of 62.43^o to 68.20^o and texture of 25.70 gf to 33.00 gf. Statistical analysis showed that cooking method had significant effects on texture, lightness, chroma, hue and moisture content of cooked rice.
Key words : cooking method; cooked rice; lowland rice varieties

Rice is one of the important commodity results in rice farming systems in lowland swamp. Lowland swamp land that had been cultivated for rice farming with cropping patterns once a year was 91%, while for rice farming with cropping twice a year **was only 9%** (Sudana, 2005). The varieties of rice grown in lowland swamp land **consisted** of various varieties namely Ciherang, Ciliwung, Mekongga, IR 10, IR 42, IR 64, Ciherang Dempo, Ciliwung Jumbo, and Rojo Lele (Syafutri, 2015). Ciherang and Ciliwung **were** several varieties widely grown by farmers in lowland swamp land. The difference of rice varieties affected the characteristics of cooked rice. According to Yadav et al. (2007), different rice varieties **had** significant effects on the physicochemical properties, morphology, and cooking properties, but Putri (2012) stated that the starch contents of rice were still the same ie more than 80%. Cooking method also **affected** the characteristics of cooked rice. According to Han et al. (2008), different cooking method affected the hydrolysis of starch rice. Cooking the raw rice into the cooked rice can be done in various ways. Indonesian people use two ways to cook rice namely conventional and modern way. The conventional **ways consist of *liwet* method (using stovetop) and combination of boiled and steamed method**. The modern way **is electric method (using rice cooker)**. Each cooking method uses different heat and **time of** cooking. The objective of this study was to analyze the effect of different lowland rice varieties and different cooking methods on physical and chemical of cooked rice.

MATERIALS AND METHODS

Rice Materials

The rice used in this study derived from lowland swamp land at East OKU, South Sumatera, Indonesia. The varieties of rice were Ciherang and Ciliwung.

Methods

This study **used** Factorial Randomized Block Design with two treatment factors and repeated three times. The treatment factors were rice variety (A) and the cooking method (B). The first factor consisted of two levels : Ciherang (A_1) and Ciliwung (A_2), where as the second factor consisted of three levels : *liwet* method (using stovetop) (B_1), combination of boiled and steamed (B_2), and rice cooker (B_3). The data obtained performed using analysis of variance (ANOVA) 5% and HSD test. The parameters of this study were physical and chemical characteristics on milled rice and cooked rice. The physical characteristics of milled rice included dimension of rice and color, where as the chemical characteristics of milled rice included moisture content, amylose content, protein content and total amino acids. The physical characteristics of cooked rice were color and texture, while the chemical characteristic was moisture content.

Liwet Method (Using Stovetop)

The procedurs of *liwet* method (Deliani, 2004) which has been modified were : first, milled rice with whole grains (100 g) cleared from foreign objects and dirt. Second, rice washed with clean water (2 times) and drained

for 2 minutes, then put in a regular pot or pan pot. Next step, water (150 mL) was added to the pot containing. Fourth, the rice cooked in a covered pot until boiling. Then, stirring done 10 times after boiling water (100°C). Sixth, if the water was up, stirred again (stirring the latter performed 5 times and the pot sealed while the fire diminished. Last, the cooking times of *liwet* method were 10 minutes.

Combination of Boiled and Steamed Method

The procedurs of boiled and steamed combination method (Deliani, 2004) which has been modified were : first, milled rice with whole grains (100 g) cleared from foreign objects and dirt. Second, rice washed with clean water (2 times) and drained for 2 minutes, then put in a regular pot or pan pot. Third, water (150 mL) was added to the pot containing. Next, the rice cooked in a covered pot to a boil for 5 minutes, then reduced the heat (during heating stirring 15 times until becoming rice (water absorbed by rice). Fifth, stirring done 10 times after boiling water (100°C) to become rice (water absorbed by rice). Then, rice stirred and moved to the steamer containing boiled water, then waited for 5 minutes.

Rice Cooker Method

The procedurs of modern cooking method (rice cooker) (Sutarjana, 2009) which has been modified were : first, milled rice with whole grains (100 g) cleared from foreign objects and dirt. Second, rice washed with clean water (2 times) and drained for 2 minutes and put in an aluminum pan on the rice cooker. Then, water (150 mL) was added. Fourth, thermostat clicked and light "cooking" light up on the rice cooker to cook the raw rice into the cooked rice. Finally, the thermostat button automatically moved from the position of the light "cooking" to the position of the lights "warmer" that shows rice cooked.

Dimention of rice

Rice dimensions included length and width. It was measured with calipers. Whole rice intact (10 seeds) taken from each variety. Length and width of rice seeds measured with calipers. The average values of length and width were taken.

Texture

Texture of rice was measured with “Brookfield” texture analyzer (Faridah et al, 2006). Brook (cylindrical type) mounted just above the sample. The needle was attached to the tip of the sample. Brooke (blade type) was pressing right in the middle of the sample. Then, on display listed number of peak load and final load (gram force).

Color

Analysis of color was measured with “Konica Minolta” Chromameter. Chromameter turned on and the button was activated to select and determine the values and numbers that be used. The values that be used were Lightness (L), Chroma (C) and Hue (H). Samples of rice were placed under the lens of Chromameter and numbers of L (%), C (%), and H (^{0}) will be shown (Munsell, 1997).

Chemical Characteristics

The chemical characteristics included moisture content, amylose content, protein content and total amino acids. Moisture content, amylose content, protein content and total amino acids were determined with method of AOAC (2006).

RESULTS

Dimention of Rice

Variety of lowland swamp rice used for this study were Ciherang and Ciliwung. Dimention averages of Ciherang and Ciliwung varieties included length and width. Rice of Ciherang variety had length of 7.01 mm and width of 2.04 mm. Rice of Ciliwung variety had length of 6.75 mm and width of 2.10 mm. The ratio between length and width of Ciherang variety was 3.44, while the ratio between length and width of Ciliwung variety ratio was 3.21.

Texture

Texture indicated as hardness of rice that cooked with some cooking methods. Physically, hardness of rice defined as rice ability to accept certein load in certain time. Analysis of texture could determine hardness and tenderness of rice. Based on this study, texture averages of cooked rice were 25.70 to 33.00 gf (Fig. 1). The analysis of variance showed that cooking method had significant effect on texture of cooked rice (Table 1), while variety of rice and interaction between cooking method and variety of rice had no significant effect on texture of cooked rice. The cooked rice that had high texture value was harder than cooked rice that had low texture value.

Color

Color analysis conducted on milled rice and cooked rice with attribute L (lightness), C (chroma) and H (hue). The maximum value of lightness was 100% that showed very white. The lightness value of Ciherang variety was 65.97%, while the lightness value of Ciliwung variety was 67.93% .

The lightness value of cooked rice with different varieties and cooking methods ranged from 73.07 to 76.20 % (Fig. 2). The highest lightness value (76.20 %) found in rice with A_2B_3 treatment (Ciliwung variety and cooking methods using the rice cooker), while the lowest lightness value (73.07 %) found in rice with A_1B_1 treatment (Ciherang variety and *liwet* methods). The high lightness value of rice indicated that the color of rice was brighter. The analysis of variance showed that cooking method had significant effect on lightness of cooked rice (Table 2), while variety of rice and interaction between cooking method and variety of rice had no significant effect on lightness of cooked rice.

The chroma value of Ciherang variety was 12.03%, while the chroma value of Ciliwung variety was 12.00%. The chroma value of cooked rice with different varieties and cooking methods ranged from 5.63 to 7.10% (Fig. 3). The highest chroma value (7.10 %) found in rice with A_1B_1 treatment (Ciherang variety and *liwet* method), while the lowest chroma value (5.63 %) found in rice with A_2B_3 treatment (Ciliwung varietiy and cooking method using the rice cooker). The analysis of variance showed that cooking method had significant effect on chroma of cooked rice (Table 3), while variety of rice and interaction between cooking method and variety of rice had no significant effect on chroma.

The hue value of Ciherang variety was 69.37^o, while the hue value of Ciliwung variety was 65.70^o. The hue value of parboiled rice with different varieties and cooking methods ranged from 62.43 to 68.20^o (Fig. 4). The highest hue value (68.20^o) found in rice with A_2B_3 treatment (Ciliwung variety and cooking method using the rice cooker), while the lowest hue value (62.43^o) found in rice with A_1B_1 treatment (Ciherang variety and *liwet* method). The analysis of variance showed that cooking method had significant effect on hue of cooked rice (Table 4), while variety of rice and interaction between cooking method and variety of rice had no significant effect on hue of cooked rice. According to hue value, Ciherang and Ciliwung varieties with different cooking method had yellow-red (YR) color.

Moisture Content

The moisture content was measured in milled rice and cooked rice. The moisture content averages of Ciherang variety was 12.27%, while the moisture content averages of Ciliwung variety was 12.22%. The moisture content of cooked rice with different varieties and cooking methods ranged from 56.01 to 57.68% (Fig. 5). The highest moisture content value (57.68%) found in rice with A_2B_1 treatment (Ciliwung variety and *liwet* method), while the lowest moisture content value (56.01%) found in rice with A_1B_2 treatment (Ciherang variety and combination of boiling and steaming method). The analysis of variance showed that cooking method had significant effect on moisture content of cooked rice (Table 5), while variety of rice and interaction between cooking method and variety of rice had no significant effect on moisture content of cooked rice.

Amylose Content

Amylose content measured in milled rice of Ciherang and Ciliwung varieties. Determination of amylose content was begun with the manufacture of standard curve. The resulting regression equation was $y = 0{,}0217x - 0.0161$. The average value of amylose content with treatment A_1 (Ciherang variety) was 22.64%, while the average value of amylose content with treatment A_2 (Ciliwung variety) was 18.85%.

Protein Content and Total Amino Acid

The result showed that protein content and total amino acids of Ciherang variety were 10.73% and 7.75% respectively, while protein content and total amino acids of Ciliwung variety were 8.98% and 6,98% respectively (Table 6). Total amino acids **that be observed consisted** of 10 types of essential amino acids and 5 types of non-essential amino acids. The most abundant amino acids contained in Ciherang and Ciliwung varieties namely glutamic acid (non-essential amino acids) of 1.68% and 1.49% respectively.

DISCUSSION

Dimention of rice included length, width, and ratio between length and width. The result showed that length of Ciherang and Ciliwung varieties **categorized as** long grain rice. **It** was consistent with research of Setyono and Wibowo (2008) which stated that a length of rice 6.6 to 7.5 mm classified as long grain rice. Based on the ratio between length and width, Ciherang and Ciliwung varieties **were classified** into long grain rice type and rice shape slender (ratio L/W $\geq$ 3,0) (Slaton et al, 2000 ; Setyono and Wibowo, 2008). The slender rice was more preferable by consumers.

Texture value indicated as hardness of cooked rice. The result of this study showed that cooking method had significant effect on texture of cooked rice. Kim et al. (1987) and Daomukda et al. (2011) stated that cooking methods affected texture of rice. The rice that cooked with *liwet* method had low texture value. It caused the texture of cooked rice was softer than the other methods. During cooking process with *liwet* method, rice **absorbed** water and starch granules in rice **would** swell. Cooking process with *liwet* method performed heating temperature setting. The heating temperature setting included the big fire which used to speed up the process of heating water reaching the boiling point temperature of water (100 ^{o}C), moderate heat to ripen the rice, and a small fire to prevent the formation of a thick crust. Setting the heating temperature **ranged** from the boiling water and rice until the rice maturation. Setting the temperature during *liwet* methods caused heat exposure on rice longer than combination of boiling and steaming method and modern method using a rice cooker. Exposure to prolonged heat **caused** the texture of rice was softer. **It** was consistent with research of Kim et al. (1987) which stated that cooking method of rice with soaking in boiling water had less hard and more cohesive texture than electric cooking. Cooking rice with combination of boiled and steamed method had the highest value of texture, so the rice produced had a harder texture than the rice produced using *liwet* method and modern method (using the rice cooker). Cooking rice with combination of boiled and steamed method had the highest average value of texture because at the time after water boiled at 100 ^{o}C, the water absorbed into the rice and then the fire was turned off. Furthermore, the rice cooled and occured re-arrangement of amylose that leads to retrogradation process before entering the stage steaming, so the texture of rice produced was louder. According to Winarno (2004), retrogradation is a re-crystallization process of starch which has undergone gelatinization. One of the factors that affect the texture of rice is gelatinization process. Rice to become cooked rice must undergo gelatinization (Marshall, 1994). Gelatinization process occured during the warm rice in water until it **became** cooked rice. Gelatinization temperature affected the ripening time. Rice that had a high gelatinization temperature needed a longer cooking time than rice that had a low gelatinization temperature.

Color analysis conducted on milled rice and cooked rice with attribute L (lightness), C (chroma) and H (hue). Lightness value indicates the brightness or darkness of a color (Winarno, 2004). The high lightness value of rice indicated that the color of rice was brighter. Lightness value of cooked rice affected by temperature and cooking time for each cooking method. The rice cooked using *liwet* methods was the lowest. Cooking process with *liwet* method performed heating temperature setting manually, which caused heat exposure on rice longer than other methods. It caused the time of cooking rice was longer. The heating time on the rice will caused a browning reaction between carbohydrates and protein, and produced darker rice (yellow-red). It indicated by low value of lightness. The rice cooked using rice cooker had the lowest value of chroma. The chroma values affected by temperature and cooking time for each cooking method. The process of cooking rice using a rice cooker required a shorter time than the other methods, so the heating process during cooking was faster. Accelerated warming process would minimize the risk of browning reaction (Maillard) on rice, so that rice produced had a weak color indicated by lower chroma values. Browning reaction (Maillard) caused higher chroma values on rice. According to hue value, Ciherang and Ciliwung varieties with different cooking method had yellow-red (YR) color. Formation of colors on rice affected by heating process during cooking rice. According to Wahyudi (2005), during the heating process occurs reaction between the protein and reducing sugar. It cause the formation of glycocylamin. Glycocylamin suffered polymerase to form melanoidin which causes color changes of rice to yellow red (Maillard reaction).

The moisture content was measured in milled rice and cooked rice. Water is one of the important elements in food stuffs. According to Sudarmadji et al. (2007), the moisture content is the amount of water contained in food, included free water and water bound physically and chemically. According to Badan Standarisasi Nasional (1999), maximum moisture content is 14% of milled rice. The moisture content of Ciherang and Ciliwung varieties according to the moisture content determined by SNI 01-6128-1999. The result of moisture content analysis also showed that cooking rice with *liwet* method had the highest moisture content, so the texture rice softer than the other methods. It occured because rice longer exposure to heat. In addition, water trapped in the pan could be absorbed back into the rice during the resting time after the fire turned off, so it affected the moisture content of the rice. The result also showed that the moisture content of rice that cooked with rice cooker was higher than rice that cooked with boiling and steaming combination. **It** was consistent with research of Daomukda et al. (2011) which stated that the moisture content of brown rice that cooked with electric cooking method was higher than steaming method.

Amylose content is one of the important criteria in the classification system of rice. The amylose content of Ciherang variety **classified as** moderate, while the amylose content with of Ciliwung variety **classified as** low. According to Allidawati and Bambang (1989), based on the amylose level, rice grouped into very low of amylose (<10%), low (10 to 20%), moderate (20 to 24%) and high (> 25%). Higher amylose content in rice increased the occurrence of rearrangement of amylose after experiencing gelatinisasi leading to retrogradation process. Rice that had high amylose would produce not sticky rice, could expand and became hard if it was cold. Moderate amylose rice had fluffier texture generally. Low amylose rice produced sticky rice, shiny, not expand, and still coagulate after a cold when cooked (Damardjati, 1995 in Indrasari et al., 2009).

The protein content of Ciherang and Ciliwung varieties were 10.73% and 8.98%, while total amino acids of Ciherang and Ciliwung varieties were 6,98% and 7.75% respectively. The most abundant amino acids contained in Ciherang and Ciliwung varieties namely glutamic acid (non-essential amino acids). According to the Nutrition Directorate of the Ministry of Health (1996), the protein content of rice per 100 grams **was** 7.6%. According to Haryadi et al. (2008) in Larasati (2012), protein content of rice **was** 7.3 to 10.2% and a maximum of 14%. According to Haryadi (2008), the rice contains higher protein **needed** more water and a longer cooking time. This **related** to the structure of the seed. The starch granules enclosed in a protein, so the absorption of water blocked by protein. It caused the time of cooking is longer.

CONCLUSION

Ciherang variety had a length and width ratio of 3.44, lightness of 65.97%, chroma of 12.03%, hue of 69,37^{o}, moisture content of 12.27%, amylose content of 22.64%, protein content of 10.73%, and total amino acids of 7.75%. Ciliwung variety had a length and width ratio of 3.21, lightness of 67.93%, chroma of 12.00%, hue of 65,70^{o}, moisture content of 12.22%, amylose content of 18.85%, protein content of 8.98%, and total amino acids of 6.98%. The method of cooking had significant effects on texture (hardness), color (lightness, chroma, hue), and moisture content of the cooked rice.

ACKNOWLEDGEMENTS

This research was supported by International Rice Research Institute (IRRI), and Research Center of Sub-Optimal Land (PUR-PLSO) Sriwijaya University.

REFERENCES

Allidawati and Bambang K. 1989. Quality Test Method of Rice in Rice Breeding Program. Center for Food Crops Research and Development, Bogor : 363-375.

AOAC. 2006. Official Methods od An Anlysis of Analysis Chemistry. Washington DC. United Stated of America.

Badan Standarisasi Nasional. 1999. Quality standards and test methods for milled rice (SNI 01-6128-1999). Jakarta.

Damardjati DS and Purwani EY. 1991. Quality of Rice. *Rice-Book 3*, 4 (4): 85-94.

Daomukda N, Moongngam A, Payakapol L and Noisuwan A. 2011. Effect of cooking methods on physicochemical properties of brown rice. *2nd International Conference on Environmental Science and Technology*, 6 : VI-1-VI-4. Singapore.

Deliani L. 2004. Studying the Effect of Several Rice Varieties Storage with Different Levels of Sticky on Parboiling Quality. FATETA. IPB. Bogor.

Han SH, Lee SW and Rhee C. 2008. Effects of cooking methods on starch hydrolysis kinetics and digestion-resistant fractions of rice and soybean. *Eur. J. Food Res. Technol.*, 227 : 1315-1321.

Haryadi. 2008. Rice Processing Technology. Gadjah Mada University Press, Yogyakarta.

Indrasari SD, Purwani EY, Widowati S and Damardjati DS. 2009. The enhancement of value added of rice through physical quality, taste and nutrition. Rice Research Institute. Sukamandi.

Kim JS, Lee HY, Kim YM and Shin DH. 1987. Effect of cooking methods on qualities of quick cooking rice. *Korean J. Food Sci. Technol*., 19 (6) : 480-485.

Larasati SP. 2012. The properties of physicochemical and organoleptic characteristics of several rice varieties [Thesis]. Department of Community Nutrition, Faculty of Human Ecology, IPB. Bogor.

Marshall WE. 1994. Starch Gelatinization in Brown and Miled Rice : A Study Using Differential Scanning Calorimetry. In Rice Science and Technology (wyne E. Marshall and James I. Wadsworth, ed). P. 205-225. Agric. Res. Serv., USDA, New Orleans.

Munsell. 1997. Colour Chart For Plant Tissu Mecbelt Division Of Kalmorgen Instrument Corporation. Baltimore Maryland.

Nutrition Directorate of the Ministry of Health. 1996. List of Food Composition. Bhratara Commerce Media. Jakarta.

Putri AS. 2012. Physical, chemical and sensory characteristics of rice retrogradation [Thesis]. Study Program of Agricultural Technology. Department of Agricultural Technology. Faculty of Agriculture, University of Sriwijaya. Indralaya.

Setyono A and Wibowo P. 2008. Selection of quality rice relationship with the characteristics of several strains of inbred and hybrid rice. *Seminar Nasional Padi* : 1525-1534.

Slaton N, Blocker M, Wilson C, Dilday R, Robinson J dan Koen B. 2000. Grain Characteristics of rice varieties. University of Arkansas Division of Agriculture, US. Department of Agriculture and County Govemments Cooperating, US.

Sudana W. 2005. Potential and prospect of wetlands as a source of agricultural production. *Analisis Kebijakan Pertanian*, 3 (2) : 141-151.

Sudarmadji S, B Haryono dan Suhardi. 1997. Analysis procedures for Foodstuff and Agriculture. Penerbit Liberty. Yogyakarta.

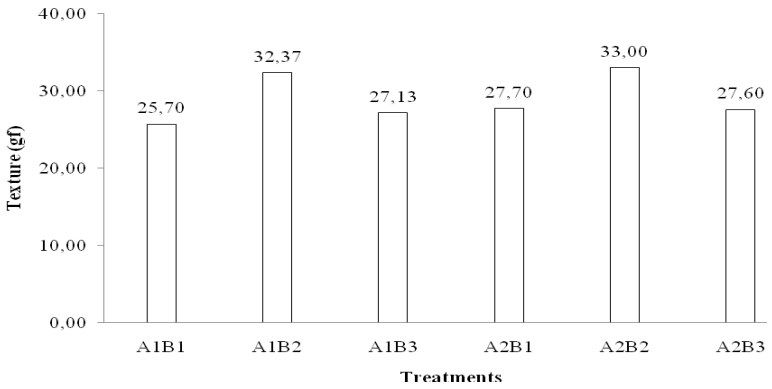
Sutarjana J. 2009. Heritage Culinary Mistress of the House : 1200 Legendary Recipes and Snacks. Gramedia Pustaka Utama. Jakarta.

Syafutri MI. 2015. Characteristics of swamp rice in South Sumatera, Indonesia [Research Report]. Sriwijaya University. Indralaya.

Wahyudi T. 2005. Assessment of Physical, Chemical and Organoleptic Quality of Rice with Several Rice Varieties [Thesis]. Department of Agricultural Technology Faculty of Agriculture, University of Sriwijaya. Indralaya.

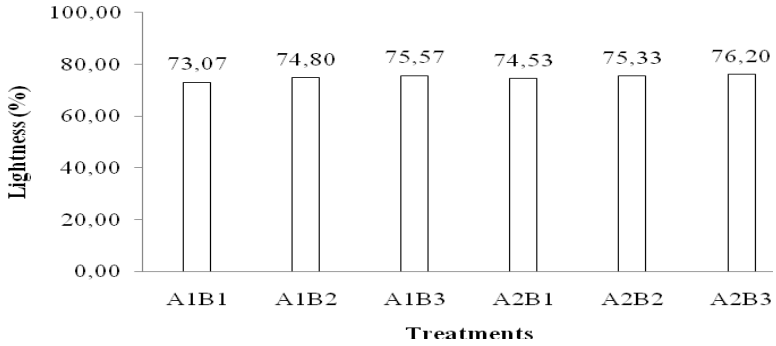
Winarno FG. 2004. Food Chemistry and Nutrition. PT. Gramedia Pustaka Utama. Jakarta.

Yadav RB, Khatkar BS dan Yadav BS. 2007. Morphological, physico chemical and cooking properties of some Indian rice (Oryza sativa L.) Cultivars. *J. Agric. Technol*., 3 (2) : 203-210.



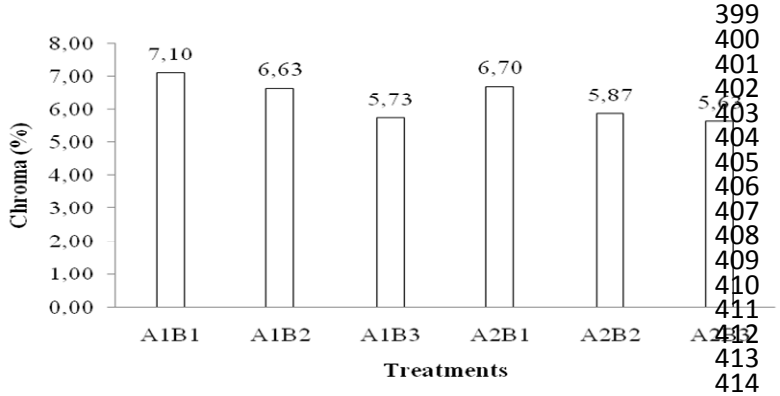
A_1 = Ciherang
A_2 = Ciliwung
B_1 = *liwet* (traditional method)
B_2 = combination of boiled and steamed
B_3 = using rice cooker

Fig. 1. Texture average of cooked rice with difference of cooking methods



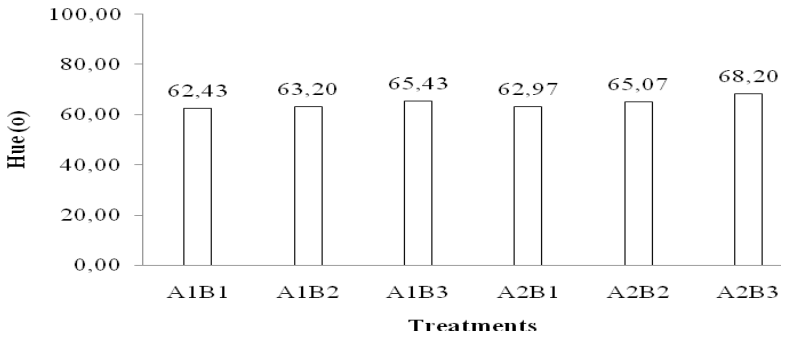
A_1 = Ciherang
A_2 = Ciliwung
B_1 = *liwet* (traditional method)
B_2 = combination of boiled and steamed
B_3 = using rice cooker

Fig. 2. Lightness average of cooked rice with difference of cooking methods



A_1 = Ciherang
A_2 = Ciliwung
B_1 = *liwet* (traditional method)
B_2 = combination of boiled and steamed
B_3 = using rice cooker

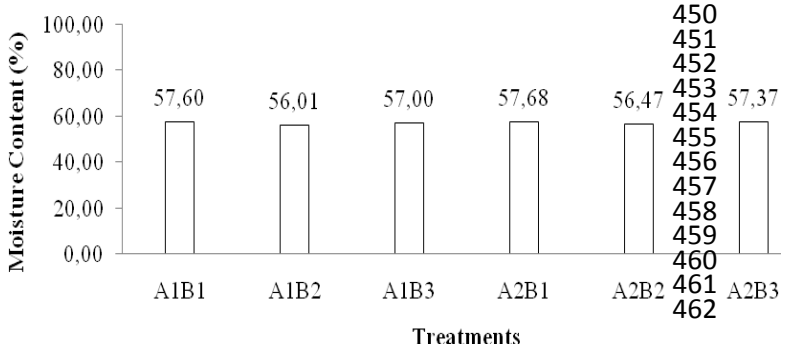
Fig. 3. Chroma average of cooked rice with difference of cooking methods



A_1 = Ciherang
A_2 = Ciliwung

B_1 = *liwet* (traditional method)
B_2 = combination of boiled and steamed
B_3 = using rice cooker

Fig. 4. Hue average of cooked rice with difference of cooking methods



A_1 = Ciherang
A_2 = Ciliwung

B_1 = *liwet* (traditional method)
B_2 = combination of boiled and steamed
B_3 = using rice cooker

Fig. 5. Moisture content average of cooked rice with difference of cooking methods

Table 1. HSD test of cooking method influence on texture of cooked rice

Cooking Methods	Texture Averages (gf)	HSD 5% = 0.58
B_1 (*liwet* (traditional method))	26.70	a
B_3 (using rice cooker)	27.37	b
B_2 (combination of boiled and steamed)	32.68	c

Table 2. HSD test of cooking method influence on lightness of cooked rice

Cooking Methods	Lightness Averages (%)	HSD 5% = 0.58
B_1 (*liwet* (traditional method))	73.80	a
B_2 (combination of boiled and steamed)	75.07	b
B_3 (using rice cooker)	75.88	c

Table 3. HSD test of cooking method influence on chroma of cooked rice

Cooking Methods	Chroma Averages (%)	HSD 5% = 0.21
B_3 (using rice cooker)	5.68	a
B_2 (combination of boiled and steamed)	6.25	b
B_1 (*liwet* (traditional method))	6.90	c

Table 4. HSD test of cooking method influence on hue of cooked rice

Cooking Methods	Hue Averages (°)	HSD 5% = 1.00
B_1 (*liwet* (traditional method))	62.70	a
B_2 (combination of boiled and steamed)	64.13	b
B_3 (using rice cooker)	66.82	c

Table 5. HSD test of cooking method influence on moisture content of cooked rice

Cooking Methods	Moisture Content Averages (%)	HSD 5% = 0.16
B_2 (combination of boiled and steamed)	56.24	a
B_3 (using rice cooker)	57.18	b
B_1 (*liwet* (traditional method))	57.64	c

Table 6. Protein content and total amino acids of Ciherang and Ciliwung varieties

Parameter	Result		Unit
	Ciherang	Ciliwung	
Protein Content	10,73	8,98	%w/w
Amino Acid			
Aspartic acid	0,79	0,69	% w/w
Glutamic acid	1,68	1,49	% w/w
Serine	0,47	0,43	% w/w
Histidine	0,21	0,19	% w/w
Glycine	0,36	0,34	% w/w
Threonine	0,29	0,27	% w/w
Arginine	0,69	0,59	% w/w
Alanine	0,47	0,43	% w/w
Tyrosine	0,30	0,26	% w/w
Methionine	0,13	0,14	% w/w
Valine	0,49	0,44	% w/w
Phenylalanine	0,49	0,44	% w/w
I-leucine	0,37	0,34	% w/w
Leucine	0,72	0,64	% w/w
Lysine	0,29	0,30	% w/w
Amino Acid Total	7,75	6,98	% w/w

License to Publish

Dear Author(s),

We need your written permission before we can publish your accepted article in *Rice Science*.

Please read this form carefully and if you agree with its terms, complete it, and then upload it to our website. Once the manuscript is accepted, the ORIGINAL should be sent by post to us at the following address: **Editorial office of Rice Science, China National Rice Research Institute, Tiyuchang Road No. 359, Hangzhou 310006, China.**

Details (please complete)

Article title: The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods

Corresponding author: Merynda Indriyani SYAFUTRI

Names of all authors in the order in which they appear in the article: Filli PRATAMA, Friska SYAIFUL, Achmad FAIZAL

The author(s) agrees to grant the China National Rice Research Institute the exclusive copyright in the manuscript identified above and any supplemental materials or other information submitted therewith that are intended for publication as part of or as a supplement to the manuscript (the “Article”) in printed, electronic or any other media, throughout the world, in all languages, for the full term of copyright, effective when and if the article is accepted for publication.

The author(s) affirms that the article is original work, has not previously been published in its current form, and is not under consideration by another journal in its current form. The author(s) also promise that the article does not contain anything that is libelous, illegal or infringes anyone's copyright or other rights. If the article contains material that is someone else's copyright, the author(s) certifies that all necessary permissions have been obtained from the copyright owners for any material included in the article in which they do not hold copyright (The relevant permissions correspondence must be attached to this form) and that the material is clearly identified and acknowledged in the text.

The author(s) retains the right to use his/her own article in the published form in any way consistent with the above, and to mount the article on his/her own or institution’s website. The author(s) may in whole or in part, use the article as the basis for his/her own further publications or spoken presentations.

We promise that we will respect your rights as the author(s). That is, we will make sure that your name(s) is/are always clearly associated with the article and, while you do allow us to make necessary editorial changes, we will not make any substantial alteration to your article without consulting you. We will have your article reviewed by impartial referees, and will let you know the outcome as quickly as we can. If the article is accepted, we undertake to publish it as soon as we reasonably can. If it is rejected, this agreement is automatically cancelled and all the rights come back to you.

Signature (on behalf of all co-authors if any)

Print name: Merynda Indriyani Syafutri

Address: Indralaya, Ogan Ilir, South Sumatera, Indonesia

Date: April 22th, 2016

Palembang-Indonesia, April 22th, 2016

Dear
Journal of Rice Science

I am Merynda Indriyani Syafutri, from Sriwijaya University, Indonesia. I am interested to publish the results of my research and team at Journal of Rice Science. The title of manuscript is "The Physical and Chemical Characteristics of Cooked Rice from Different Some Lowland Rice Varieties and Cooking Methods". I also have repaired my manuscript based on the inputs from reviewers. I hope this manuscript can be processed and published in the journal of Rice Science. Thank you.

Best regards
Merynda Indriyani Syafutri

RICE SCIENCE

Title page includes the following information on this page:

Full title: The Physical and Chemical Characteristics of Cooked Rice from Some Different Lowland Rice Varieties and Cooking Methods

Running title: SYAFUTRI : Characteristics of Cooked Rice

All author(s) name(s):
Corresponding author:
Name: Merynda Indriyani SYAFUTRI
Address: Department of Agricultural Technology, Faculty of Agriculture, Sriwijaya University Jalan Raya Palembang-Prabumulih KM 32, Indralaya, Ogan Ilir, South Sumatera, Indonesia 30662
Tel/Fax: 0711 580664
E-mail: misyafutri@yahoo.com / misyafutri@gmail.com
Author affiliation: Filli PRATAMA, Friska SYAIFUL, Achmad FAIZAL

Financial support: International Rice Research Institute (IRRI)
Acknowledgement: International Rice Research Institute (IRRI), and Research Center of Sub-Optimal Land (PUR-PLSO) Sriwijaya University

Submission date: April 22th, 2016
Other information: -

HOSTED BY
ELSEVIER

Available online at www.sciencedirect.com

ScienceDirect

Rice Science, 2016, 23(5): −

Effects of Varieties and Cooking Methods on Physical and Chemical Characteristics of Cooked Rice

Merynda Indriyani SYAFUTRI, Filli PRATAMA, Friska SYAIFUL, Achmad FAIZAL

(*Department of Agricultural Technology, Faculty of Agriculture, Universitas Sriwijaya Jalan Raya Palembang-Prabumulih KM 32, Indralaya 30662, Ogan Ilir, South Sumatera, Indonesia*)

Abstract: To analyze the effect of different lowland rice varieties and different cooking methods on physical and chemical characteristics of cooked rice. A factorial randomized block design with two factors was used and each combination of the factors was repeated three times. The first factor was rice variety (Ciherang and Ciliwung) and the second factor was the cooking method (stovetop, boiling and steaming, and rice cooker). Results showed that Ciherang and Ciliwung varieties were classified into slender grain rice type with yellow-red color. The amylose content of Ciherang was classified as moderate, while the amylose content of Ciliwung classified as low. The most abundant amino acid contained in Ciherang and Ciliwung varieties was glutamic acid. Statistical analysis showed that cooking method had significant effects on texture, lightness, chroma, hue and moisture content of cooked rice. Rice cooked with *liwet* method had the lowest texture value, lowest lightness value, highest chroma value, and highest moisture content.

Key words: physical and chemical characteristic; cooking method; rice; variety; amino acid

Rice was one of the most important commodity results in farming systems in the lowland swamp of Indonesia. Lowland swamp land cultivated for rice farming with cropping pattern once a year was 91%, while for rice farming with cropping pattern twice a year was only about 9% (Sudana, 2005). Various rice varieties namely Ciherang, Ciliwung, Mekongga, IR10, IR42, IR64, Ciherang Dempo, Ciliwung Jumbo and Rojo Lele were grown in lowland swamp area (Syafutri, 2015). Ciherang and Ciliwung were varieties widely grown by farmers in lowland swamp land. The difference of rice varieties would affect the characteristics of cooked rice produced. According to Yadav et al (2007), different rice varieties showed significant effects on the physicochemical properties, morphology and cooking properties, but Putri (2012) stated that the starch content of rice was still the same, ie more than 80%. Cooking method also affected the characteristics of cooked rice. According to Han et al (2008), different cooking method would affect the hydrolysis of starch rice. Cooking the raw rice into the cooked rice could be done in various ways. Indonesian people used two ways to cook rice namely conventional and modern ways. The conventional way consisted of *liwet* method using stovetop, and combination of boiling and steaming method. The modern way was cooking rice using electric rice cooker. Each cooking method used different heat and cooking time. The objective of this study was to analyze the effect of different lowland rice varieties and different cooking methods on physical and chemical characteristics of cooked rice.

MATERIALS AND METHODS

Rice materials

Rice varieties Ciherang and Ciliwung were derived from lowland swamp land at East Ogan Komering Ulu, South Sumatera, Indonesia.

Cooking methods

Factorial randomized block design was used with two treatment factors and three repetitions. The treatment factors were rice variety (A) and the cooking method (B). The first factor consisted of two levels, Ciherang (A_1) and Ciliwung (A_2), whereas the second factor consisted of three levels, *liwet* method using stovetop (B_1), combination of boiling and steaming (B_2) and rice cooker (B_3). The data obtained were evaluated using analysis of variance (ANOVA) and honestly significant difference test at the 5% level. Physical and

Received: 17 November 2015; **Accepted:** 5 May 2016
Corresponding author: Merynda Indriyani SYAFUTRI (misyafutri@yahoo.com; misyafutri@gmail.com)

Peer review under responsibility of China National Rice Research Institute
http://dx.doi.org/

chemical characteristics of milled rice and cooked rice were studied.

Liwet method using stovetop

The procedures of *liwet* method (Deliani, 2004) which have been modified were: first, milled rice with whole grains (100 g) was cleared from foreign objects and dirt. Second, rice was washed with clean water (2 times) and drained for 2 min, then put in a regular pot or pan pot. Next step, water (150 mL) was added to the pot containing. Fourth, the rice was cooked in a covered pot until boiling. Then, stirring was alone done 10 times after water boiling (100 °C). Sixth, if the water was up, stirred again (stirring the latter performed 5 times and the pot sealed while the fire diminished). Last, the cooking times of *liwet* method were 10 min.

Combination of boiling and steaming method

The procedures of boiling and steaming combination method (Deliani, 2004) which have been modified were: first, milled rice with whole grains (100 g) was cleared from foreign objects and dirt. Second, rice was washed with clean water (2 times) and drained for 2 min, then put in a regular pot or pan pot. Third, water (150 mL) was added to the pot containing. Next, the rice was cooked in a covered pot to a boil for 5 min, then reduced the heat (during heating stirring 15 times until becoming rice (water absorbed by rice). Fifth, stirring was done 10 times after water boiling (100 °C) to become rice (water absorbed by rice). Then, rice was stirred and moved to the steamer containing boiled water, then waited for 5 min.

Rice cooker method

The procedures of modern cooking method (rice cooker) (Sutarjana, 2009) which have been modified were: first, milled rice with whole grains (100 g) was cleared from foreign objects and dirt. Second, rice was washed with clean water (2 times) and drained for 2 min and put in an aluminum pan on the rice cooker. Then, 150 mL water was added. Fourth, thermostat was clicked and light 'cooking' light up on the rice cooker to cook the raw rice into the cooked rice. Finally, the thermostat button will automatically moved from the position of the light 'cooking' to the position of the lights 'warmer' that shows rice cooked.

Measurement of physical and chemical characteristics

The physical characteristics of milled rice included size (dimentions of rice) and color, whereas the chemical characteristics of milled rice included moisture content, amylose content, protein content and total amino acids. The physical characteristics of cooked rice were color and texture, while the chemical characteristic was moisture content.

Rice dimensions including length and width were measured using calipers. Whole rice intact (10 seeds) was taken from each variety. Texture of rice was measured with 'Brookfield' texture analyzer (Faridah et al, 2006). Brook (cylindrical type) mounted just above the sample. The needle was attached to the tip of the sample. Speed of texture analyzer was set. Brooke (blade type) pressing right in the middle of the sample. Then, on display listed number of peak load and final load (gram force). Analysis of color was measured using Konica Minolta Chromameter. Lightness (L, %), chroma (C, %) and hue (H, %) were measured according to Anonymous (1997). Chemical characteristics were determined using method of AOAC (2006).

RESULTS

Dimentions of rice

Ciherang had length of 7.01 mm and width of 2.04 mm, whereas Ciliwung had length of 6.75 mm and width of 2.10 mm. The ratio of length and width for Ciherang was 3.44, while that for Ciliwung was 3.21.

Texture

Texture indicated the hardness of rice. Physically, hardness of cooked rice defined as rice ability to accept certain load in certain time. Analysis of texture could determine hardness and tenderness of rice. Based on this study, average textures of cooked rice were 25.70 to 33.00 gf (Fig. 1). Analysis of variance showed that cooking method had significant effect on texture of cooked rice, while rice variety and interaction between cooking method and rice variety had no significant effect on texture of cooked rice. The cooked rice with high texture value was harder than that of low texture value.

Color

Color analysis was conducted on milled rice and cooked rice with attributes of lightness, chroma and hue. The maximum value of lightness was 100% that showed very white.

The lightness values of milled rice were 65.97% (Ciherang) and 67.93% (Ciliwung). The lightness values of cooked rice with different varieties and cooking methods ranged from 73.07% to 76.20% (Fig. 1). The highest lightness value (76.20%) was found in rice with A_2B_3 treatment (Ciliwung variety and cooking method using the rice cooker), while the lowest lightness value (73.07%) was found in rice with A_1B_1 treatment (Ciherang variety and *liwet* method). The high lightness value of rice indicated that the color of rice was brighter. The analysis of variance showed that cooking method had significant effect on lightness of cooked rice, while rice variety and interaction between cooking method and rice variety had no significant effect on lightness of cooked rice.

The chroma values of milled rice were 12.03% (Ciherang) and 12.00% (Ciliwung). The chroma values of cooked rice with different varieties and cooking methods ranged from 5.63% to 7.10% (Fig. 1). The highest chroma value (7.10%) was found in rice with A_1B_1 treatment (Ciherang variety and *liwet* method), while the lowest chroma value (5.63%) was found in rice with A_2B_3 treatment (Ciliwung variety and cooking method using the rice cooker). The analysis of variance showed that cooking method had significant effect on chroma of

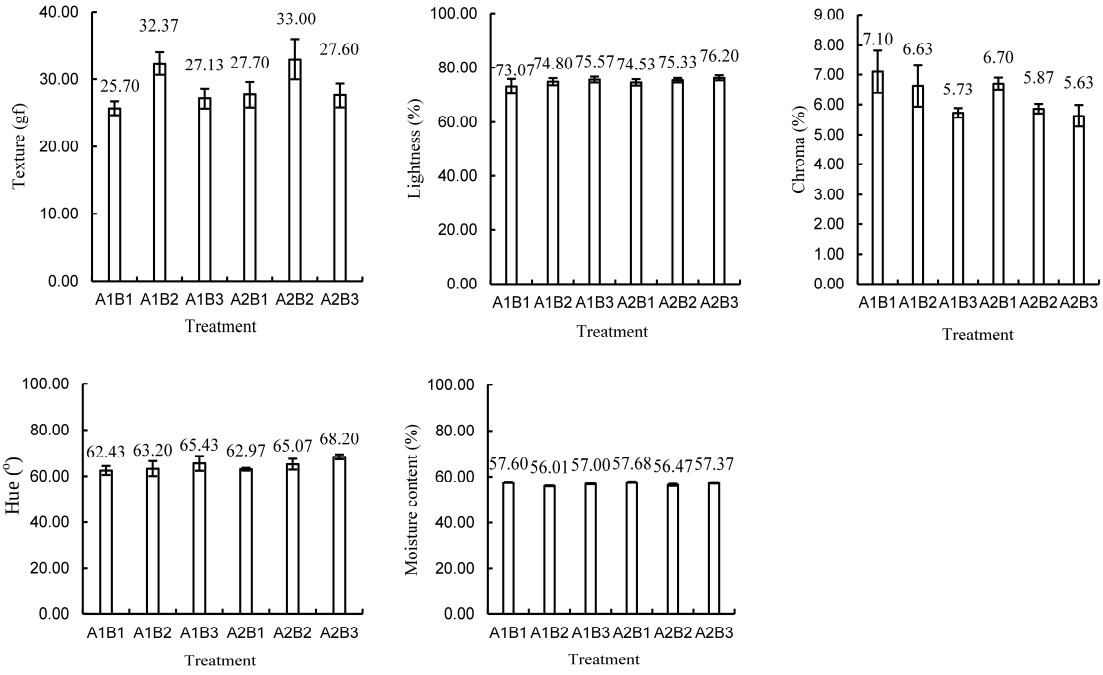


Fig. 1. Physical and chemical characteristics of cooked rice.
A1, Ciherang; A2, Ciliwung; B1, *Liwet*; B2, Combination of boiling and steaming method; B3, Rice cooker.

cooked rice, while rice variety and interaction between cooking method and rice variety had no significant effect on chroma.

The hue values of milled rice were 69.37° (Ciherang) and 65.70° (Ciliwung). The hue values of cooked rice with different varieties and cooking methods ranged from 62.43° to 68.20° (Fig. 1). The highest hue value (68.20°) was found in rice with A_2B_3 treatment (Ciliwung variety and cooking method using the rice cooker), while the lowest hue value (62.43°) was found in rice with A_1B_1 treatment (Ciherang variety and *liwet* method). The analysis of variance showed that cooking method had significant effect on hue of cooked rice, while rice variety and interaction between cooking method and rice variety had no significant effect on hue of cooked rice. According to hue value, Ciherang and Ciliwung varieties with different cooking method had yellow-red (YR) color.

Moisture content

The moisture content was measured in milled rice and cooked rice. The average moisture content of Ciherang was 12.27%, while that of Ciliwung was 12.22%. The moisture contents of cooked rice with different varieties and cooking methods ranged from 56.01% to 57.68% (Fig. 1). The highest moisture content value (57.68%) was found in rice with A_2B_1 treatment (Ciliwung variety and *liwet* method), while the lowest moisture content (56.01%) was found in rice with A_1B_2 treatment (Ciherang variety and combination of boiling and steaming method). The analysis of variance showed that cooking method had significant effect on moisture content of cooked rice, while rice variety and interaction between cooking method and rice variety had no significant effect on moisture content of cooked rice.

Amylose content

Determination of amylose content was started with the making of standard curve, where the resulting regression equation was $y = 0.0217x - 0.0161$. The average value of amylose content with treatment A_1 (Ciherang) was 22.64%, while the average value of amylose content with treatment A_2 (Ciliwung) was 18.85%.

Protein content and total amino acid

Protein content and total amino acids of Ciherang were 10.73% and 7.75%, respectively, while protein content and total amino acids of Ciliwung were 8.98% and 6.98%, respectively (Table 1). Total amino acids were observed consisting of 10 essential amino acids and 5 non-essential amino acids. The most abundant amino acids contained in Ciherang and Ciliwung, namely glutamic acid (non-essential amino acids), were 1.68% and 1.49%, respectively.

DISCUSSION

According to Setyono and Wibowo (2008), a length of 6.6 to 7.5 mm was classified as long grain rice. Based on the ratio between length and width, Ciherang and Ciliwung were included into long grain rice type and rice shape slender (ratio of length and width ≥ 3.0) (Slaton et al, 2000; Setyono and Wibowo, 2008). The slender rice was more preferable by consumers.

Rice cooked with *liwet* method had low texture value. It

Table 1. Protein and total amino acid contents of Ciherang and Ciliwung varieties.

Component	Ciherang	Ciliwung
Protein	10.73	8.98
Total amino acid	7.75	6.98
Aspartic acid	0.79	0.69
Glutamic acid	1.68	1.49
Serine	0.47	0.43
Histidine	0.21	0.19
Glycine	0.36	0.34
Threonine	0.29	0.27
Arginine	0.69	0.59
Alanine	0.47	0.43
Tyrosine	0.30	0.26
Methionine	0.13	0.14
Valine	0.49	0.44
Phenylalanine	0.49	0.44
I-leucine	0.37	0.34
Leucine	0.72	0.64
Lysine	0.29	0.30

caused the texture of cooked rice softer than the other methods. During cooking process with *liwet* method, rice absorbed water and starch granules would swell. Cooking process with *liwet* method performed heating temperature setting. The heating temperature setting included the big fire which used to accelerate the process of heating water reaching the boiling point temperature of water (100 ^{o}C), moderate heat to ripen the rice, and a small fire to prevent the formation of a thick crust. Heating temperature setting was done from the boiling water and rice to the rice maturation. Setting the temperature during *liwet* methods caused heat exposure on rice longer than the other two methods. Exposure to prolonged heat caused the texture of rice softer. Cooking rice with combination of boiling and steaming method had the highest value of texture, so the rice produced had a harder texture than the other two methods. Cooking rice with combination of boiling and steaming method had the highest average value of texture because at the time after water boiled at 100 ^{o}C, the water was absorbed into the rice and then the fire was turned off. Furthermore, the rice cooled and occured re-arrangement of amylose that leads to retrogradation process before entering the stage steaming, so the texture of rice produced was louder. According to Winarno (2004), retrogradation was a re-crystallization process of starch which had undergone gelatinization. One of the factors that affect the texture of rice was gelatinization process, which was necessary for cooked rice (Marshall, 1994). Gelatinization process occured during the rice heating in water until it became cooked rice. Gelatinization temperature affected the ripening time. Rice with a high gelatinization temperature needed a longer cooking time than rice with a low gelatinization temperature.

Lightness indicated the brightness or darkness of a color (Winarno, 2004). High lightness value of rice indicated that the color of rice was brighter. Lightness value of cooked rice was affected by cooking temperature and time. The rice cooked using *liwet* method had the lowest lightness value. Cooking process with *liwet* method performed heating temperature setting manually, which caused heat exposure on rice longer than other methods. This heating process caused a browning reaction between carbohydrates and protein, and produced darker rice (yellow-red), indicated by low value of lightness. The rice cooked using rice cooker had the lowest value of chroma. The chroma values were affected by temperature and cooking time for each cooking method. The cooking process using a rice cooker required shorter time than the other methods, so the heating process for cooker was faster. Accelerated warming process would minimize the risk of browning reaction (Maillard) on rice, so that rice produced had a weak color indicated by lower chroma values. Browning reaction (Maillard) caused higher chroma values on rice. According to hue value, Ciherang and Ciliwung had yellow-red color. Formation of colors on rice was affected by heating process. During the heating process, reaction between the protein and reducing sugar occured, and it caused the formation of glycocylamine. Glycocylamine suffered polymerase to form melanoidin which caused color changes of rice to yellow red (Maillard reaction) (Wahyudi, 2005).

Water was one of the important elements in food stuffs. According to Sudarmadji et al (2007), the moisture content was the amount of water contained in food, including free water and water bound physically and chemically. According to Anonymous (1999), the maximum moisture content of milled rice was 14%. Cooking rice with *liwet* method had the highest moisture content, because of longer rice exposure to heat so the texture was softer than that of the other methods. In addition, water trapped in the pan could be absorbed back into the rice during the resting time after the fire turned off, so it affected the moisture content of the rice.

Amylose content was one of the important criteria in the classification system of rice. The amylose content of Ciherang was classified as moderate, while the amylose content of Ciliwung classified as low. According to Allidawati and Bambang (1989), based on the amylose level, rice was grouped into very low amylose (< 10%), low (10% to 20%), moderate (20% to 24%) and high (> 25%). Higher amylose content in rice increased the occurrence of rearrangement of amylose after experiencing gelatinization leading to retrogradation process. Rice with high amylose would produce no sticky rice, could expand and became hard when it was cold. Moderate amylose rice had fluffier texture generally. Low amylose rice produced sticky rice, shiny, not expand, and still coagulate after cold (Damardjati, 1995; Indrasari et al, 2009).

Protein content of Ciherang and Ciliwung were 10.73% and 8.98%, while total amino acids of Ciherang and Ciliwung were 6.98% and 7.75%, respectively. The most abundant amino acid in Ciherang and Ciliwung was glutamic acid (non-essential amino acids). According to the Nutrition Directorate of the Ministry of Health (1996), the protein content of rice was 7.6%. According to Haryadi et al (2008) and Larasati (2012), protein contents of rice ranged from 7.3% to 10.2% and a maximum of 14.0%. According to Haryadi (2008), the rice containing higher

protein needed more water and a longer cooking time. This related to the structure of rice grains. The starch granules enclosed in a protein, so the absorption of water was blocked by protein, which resulted in a longer time of cooking.

CONCLUSION

Ciherang had a length and width ratio of 3.44, lightness of 65.97%, chroma of 12.03%, hue of 69.37^{o}, moisture content of 12.27%, amylose content of 22.64%, protein content of 10.73%, and total amino acid of 7.75%. Ciliwung had a length and width ratio of 3.21, lightness of 67.93%, chroma of 12.00%, hue of 65.70^{o}, moisture content of 12.22%, amylose content of 18.85%, protein content of 8.98%, and total amino acid of 6.98%. Cooking method had significant effects on texture (hardness), color (lightness, chroma and hue) and moisture content of the cooked rice.

ACKNOWLEDGEMENTS

This research was supported by International Rice Research Institute (IRRI), and Research Center of Sub-Optimal Land (PUR-PLSO) Universitas Sriwijaya.

REFERENCES

Allidawati, Bambang K. 1989. Quality Test Method of Rice in Rice Breeding Program. Bogor, Indonesia: Center for Food Crops Research and Development: 363–375.

Anonymous. 1997. Munsell Colour Chart of Tissue. Maryland: Baltimore.

Anonymous. 1999. Quality Standards and Test Methods for Milled Rice (SNI 01-6128–1999). Jakarta, Indonesia: National Standardization Agency.

AOAC. 2006. Official Methods of Analysis. Washington DC, USA: Association of Official Analytycal Chemistry.

Damardjati D S, Purwani E Y. 1991. Quality of Rice. Sukamandi, Indonesia: Crops Research Institute for Food, **4**(4): 85–94.

Deliani L. 2004. Studying the Effect of Several Rice Varieties Storage with Different Levels of Sticky on Parboiling Quality. Bogor, Indonesia: Faculty of Agricultural Technology, Bogor Agricultural University.

Faridah D N, Kusumaningrum H D, Wulandari N, Indrasti D. 2006. Analysis Laboratory. Bogor, Indonesia: Department of Science and Technology, Bogor Agricultural University.

Han S H, Lee S W, Rhee C. 2008. Effects of cooking methods on starch hydrolysis kinetics and digestion-resistant fractions of rice and soybean. *Eur J Food Res Technol*, **227**(5): 1315–1321.

Haryadi. 2008. Rice Processing Technology. Yogyakarta, Indonesia: Gadjah Mada University Press.

Indrasari S D, Purwani E Y, Widowati S, Damardjati D S. 2009. The enhancement of value added of rice through physical quality, taste and nutrition. Sukamandi, Indonesia: Rice Research Institute.

Larasati S P. 2012. The properties of physicochemical and organoleptic characteristics of several rice varieties. Bogor, Indonesia: Department of Community Nutrition, Faculty of Human Ecology, Bogor Agricultural University.

Marshall W E. 1994. Starch Gelatinization in Brown and Miled Rice: A Study Using Differential Scanning Calorimetry. *In*: Marshall W E, Wadsworth J I. Rice Science and Technology. United States Department of Agriculture, New Orleans: 205–225.

Nutrition Directorate of the Ministry of Health. 1996. List of Food Composition. Jakarta, Indonesia: Bhratara Niaga Media Press.

Putri A S. 2012. Physical, chemical and sensory characteristics of rice retrogradation. Indralaya, Indonesia: Study Program of Agricultural Technology. Department of Agricultural Technology, Faculty of Agriculture, Universitas Sriwijaya.

Setyono A, Wibowo P. 2008. Selection of quality rice relationship with the characteristics of several strains of inbred and hybrid rice. *Nat Sem Rice*: 1525–1534.

Slaton N, Blocker M, Wilson C, Dilday R, Robinson J, Koen B. 2000. Grain Characteristics of Rice Varieties. Arkansas, USA: Department of Agriculture and County Govemments Cooperating, University of Arkansas Division of Agriculture.

Sudana W. 2005. Potential and prospect of wetlands as a source of agricultural production. *Agric Policy Anal*, **3**(2): 141–151.

Sudarmadji S, dan Suhardi B H. 2007. Analysis Procedures for Foodstuff and Agriculture. Yogyakarta, Indonesia: Liberty Press.

Sutarjana J. 2009. Heritage Culinary Mistress of the House: 1200 Legendary Recipes and Snacks. Jakarta, Indonesia: Gramedia Pustaka Utama Press.

Syafutri M I. 2015. Characteristics of Swamp Rice in South Sumatera, Indonesia. Indralaya, Indonesia: Universitas Sriwijaya.

Wahyudi T. 2005. Assessment of Physical, Chemical and Organoleptic Quality of Rice with Several Rice Varieties. Indralaya, Indonesia: Department of Agricultural Technology Faculty of Agriculture, Universitas Sriwijaya.

Winarno F G. 2004. Food Chemistry and Nutrition. Jakarta, Indonesia: Gramedia Pustaka Utama Press.

Yadav R B, Khatkar B S, Yadav B S. 2007. Morphological, physicochemical and cooking properties of some Indian rice (*Oryza sativa* L.) cultivars. *J Agric Technol*, **3**(2): 203–210.

(Managing Editor: FANG Hongmin)