

附件 6



**中国科学院大学**  
University of Chinese Academy of Sciences

## 博士学位论文评阅书

论文题目 Microbial lipid production on amino acid-rich  
wastes

作者姓 Rasool Kamal

学位类别 Doctoral of Engineering

学科（专业） Biochemical Engineering

研究所（院系） Dalian Institute of Chemical Physics

中国科学院大学制

## 学术道德评价

(一票否决)

评价要素	评价意见 (请在相应栏内划“√”)
是否存在剽窃他人成果、伪造数据、由他人代写等严重作假行为	<input type="checkbox"/> 是 (具体说明存在的问题)
	<input checked="" type="checkbox"/> 否

## 评阅意见

评 价 要 素			权重	具体得分 (百分制)
1	论文选题	选题的理论意义、实用价值	10%	7
2	文献综述	反映该学科及相关领域的前人成果和前沿动态	15%	11
3	创新成果	论文成果创新性, 对学科发展、技术进步、经济建设、国家安全等方面产生的影响和贡献	40%	28
4	基础理论和专门知识	基础理论的宽厚度、坚实度, 专门知识的系统性、深入性	10%	7
5	科研能力	论文体现科研潜质与独立科研能力	15%	11
6	论文写作	论文结构、撰写规范性; 文字表达准确、清晰和流畅性; 引文严谨、规范性	10%	8
总体评价			总分	72

注: “分数”栏每项均按百分制整数评分, 各项满分均为 100 分。评分分为四档: 大于等于 90 分为优秀; 大于等于 75 分小于 89 分为良好; 大于等于 60 分小于 74 分为一般; 小于 60 分为差。

**对学位论文的学术评语：**（请对论文的学术水平、创新性做出简要评述，包括选题意义，文献资料的掌握，论文创新之处，写作规范和逻辑性等。还须明确指出论文中存在的问题和不足之处。可另附页）

**论文题目：** Microbial lipid production on amino acid-rich wastes

**作者姓名：** Rasool Kamal

In this thesis, Rasool Kamal studied the biotransformation of amino acid-rich (waste) materials into lipids by using the oleaginous fungi, which might reduce the lipid production costs. More interestingly, he found the supplement of proline at an optimum concentration of 0.5 g/L in crude glycerol could significantly increase lipid production. His thesis is well written and organized smoothly; the literature is referred to and cited appropriately; The novelty of his studies is high.

A few points should be addressed sufficiently.

1. There are plenty of typos in this thesis.
2. PAGE 32, "initial cell mass concentration of 7.0 g/L", however, on PAGE 35, "an initial cell mass of 6.90 g/L".
3. There is no composition list related to SVAA, MIAA and FMAA as mentioned in PAGE 35. Although table 3.1 (PAGE 49) shows the composition, according to table 2.4, it seems that the amino acid blends used in chapters 2 and 3 are different.
4. PAGE 35, "Over 49% of total AA were consumed for the experiments those with SVAA blends and MIAA blends, however, only 25% of total AA consumption was achieved in terms of FMAA blends." It is better to cite Table 2.4, if the calculation is based on Table 2.4.
5. Because there are various medium composition and conditions related to each figure, I suggest appending the key information about medium composition and conditions to each figure.
6. Table 2.5 in PAGE 44, did the author measured the amino acids after autoclave, I suppose that some amino acids are degraded or oxidized (for example cysteine) during autoclave. More than 43 g/L of cysteine was disappeared, but no cells and lipids are generated.
7. Chapter 3, the initial cell mass of each experiment is confused. In PAGE 49, "initial cell density of 4.0 g/L (unless otherwise stated)". For *T. cutaneum* AS 2.571 and *L. starkeyi* AS 2.1560, 7.0 g/L cell mass was initially used. However, for *R. toruloides*, the amount of initial cell mass was not mentioned, so I supposed it is 4 g/L. In this case, why the author used a different amount of initial cell mass for these three fungi. Moreover, three amino acid blends were used for *R. toruloides* but only two for *T. cutaneum* and *L. starkeyi*. I also very curious about how to prepare these three amino acid blends to make sure the carbon concentration of 28 g/L (Figure 3.3) in the case of the composition of these three amino acid blends is fixed as mentioned in Table 3.1.
8. PAGE 57, Table 3.2, "Pro" is not clear. As three media (Pro-16, Pro-28 and Pro-40) was used. The author should specify which one is the exact sample used for FAME measurement.
9. PAGE 61, "*C. Curvatus* ATCC 20509" should be *C. curvatus* ATCC 20509. Table 4.1 should be Table 3.1, because there is no such Table 4.1 in the thesis. I also found the citation to Table 4.1 many times, so please change. Also, the author should change Table 4.2, Table 4.3 and Table 4.4 sequentially.
10. PAGE 61, "an initial cell mass concentration of 7.0 g/L" however, on PAGE 64, "with a final cell mass of 7.4 g/L".
11. PAGE 68, 23.2 g/L residual glycerol in the second row, which is more than 20 g/L initially used.
12. PAGE 73 "co-supplied with different amount of same concentrations of each SVAA and glycerol (1:1 ratio: same amount of each SVAA and glycerol)", change to "co-supplied with different amount of SVAA and

glycerol (1:1 ratio)". ".....each SVAA and glycerol (Figure 4.7g)" change to ".....each SVAA and glycerol (Figure 4.7c and 4.7g)". ".....a bit higher glycerol i.e., 34.4 g/L compared with 26.8 g/L [redacted] on the media containing 40 g/L each AA and glycerol (Figure 4.7g)." change to ".....a bit higher glycerol i.e., 34.4 g/L compared with 26.8 g/L [redacted] on the media containing 40 g/L each AA and glycerol (Figure 4.7g)."

13. Maybe re-organize Figure 4.7 to align a b c g well with d, e, f and h.
14. PAGE 82, ".....200 rpm for 120 h (unless otherwise specified).", so I suppose that the cultivation time is 120 h. PAGE 86, Figure 5.2, the cultivation time is 144 h and the lipid yield is 0.26 the cell samples cultivated for 144 h. However, in Table 5.5 you mixed these two samples (the first two rows), I suppose, with the samples mentioned in Fig 5.5, which are the cell samples cultivated for 120 h. I totally DO NOT agree this is an appropriate way the present these data. I suggest you to use the first two rows to show the data about G-50 and GP-50 as mentioned in Figure 5.5. And append two rows to show the data from the cell samples cultivated for 144 h as mentioned in Figure 5.2. You also have to specify the sample information including the cultivation time in Table 5.5.
15. PAGE 85, ".....quick gradual decrease in L-proline uptake", change to ".....quick decrease in L-proline concentration". "the rapid L-proline uptake might [redacted] due to", change to "the rapid L-proline uptake might be due to". "as well as [redacted] glycerol consumption in both" change to "as well as [redacted] glycerol consumption in both".
16. PAGE 88 and Figure 5.4, switch G+MeOH and G-MeOH, as you mentioned in the text, G+MeOH seems the sample autoclaved and no methanol in the medium, and G-MeOH is the sample with methanol. In order to make it clear, it is better to use G+MeOH and G-MeOH to specify the samples with and without methanol, respectively.
17. Figure 5.4b, 5.5b, 5.6b, 5.7b, 5.8b. it is not appropriate to show the data with line charts, as these samples are independent. Maybe use scatter plots or bar chart.
18. PAGE 93, "reached the highest i.e., 47.3 g/L and [redacted]" change to "reached the highest i.e., 47.3 g/L and [redacted]".
19. PAGE 101, "(4) The effects of various AA supplements individually or in designated blends were illustrated on the red yeast *R. toruloides* lipid production efficiency [redacted]." I suppose you have done this in Chapter 5, but unfortunately, you did not do this experiment. Instead, in chapter 3 (PAGE 55 Figure 3.4), you evaluate the effect of individual amino acid on lipid production, however, in this experiment, no crude glycerol was used as co-substrate.

是否同意组织学位论文答辩

(请在相应栏内划“√”)

☒ 同意答辩

☐ 修改后答辩

☐ 不同意答辩

## 学术道德评价

(一票否决)

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3	创新成果	论文成果创新性, 对学科发展、技术进步、经济建设、国家安全等方面产生的影响和贡献	40%	30
4	基础理论和专门知识	基础理论的宽厚度、坚实度, 专门知识的系统性、深入性	10%	8
5	科研能力	论文体现科研潜质与独立科研能力	15%	12
6	论文写作	论文结构、撰写规范性; 文字表达准确、清晰和流畅性; 引文严谨、规范性	10%	9
总体评价			总分	80

注: “分数”栏每项均按百分制整数评分, 各项满分均为 100 分。评分分为四档: 大于等于 90 分为优秀; 大于等于 75 分小于 89 分为良好; 大于等于 60 分小于 74 分为一般; 小于 60 分为差。

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论文题目：Microbial lipid production on amino acid-rich wastes

作者姓名：Rasool Kamal

本论文旨在解决废弃蛋白质的资源化利用生成生物柴油的前体物质，系统研究了以氨基酸作为碳源在微生物生成油脂的过程中，对于氨基酸的偏好性，同时研究了不同菌种对于不同来源的废弃蛋白的利用生成油脂的评估，选题对实际应用废弃的蛋白质具有指导作用。具体的研究结果如下：

1. 酵母 *C. curvatus* ATCC 20509 可以在中性或碱性条件下利用氨基酸生成细胞含量 45% 的油脂
2. 通过筛选获得 *R.toruloides* CGMCC2.1389 可以最佳利用脯氨酸，油脂可以达到细胞含量的 37.3%；混合 MIAA 和 SVAA，可以获得接近 30% 的细胞中油脂的含量
3. 混合氨基酸和甘油在 *C. curvatus* ATCC 20509 中油脂产率达到 0.139 g/g
4. *R.toruloides* CGMCC2.1389 在甘油存在的条件下，L-脯氨酸促进细胞的生长油脂的生产

建议：

1. 在文献综述部分研究了不同氨基酸的代谢途径，而在实验部分有很详尽的数据体现不同氨基酸的利用率不一样，是否可以关联这两部分信息，实验结果进行分析？
2. 对于 P101 页的结论 4 认为 L-脯氨酸可以作为抗压剂，那怎样关联油脂的积累？可以具体讨论一下
3. 数据很多，应该对数据进行进一步地分析。

是否同意组织学位论文答辩

（请在相应栏内划“√”）

☒ 同意答辩

☐ 修改后答辩

☐ 不同意答辩

## 学术道德评价

(一票否决)

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	<input checked="" type="checkbox"/> 否

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1	论文选题	选题的理论意义、实用价值	10%	90
2	文献综述	反映该学科及相关领域的前人成果和前沿动态	15%	180
3	创新成果	论文成果创新性, 对学科发展、技术进步、经济建设、国家安全等方面产生的影响和贡献	40%	75
4	基础理论和专门知识	基础理论的宽厚度、坚实度, 专门知识的系统性、深入性	10%	70
5	科研能力	论文体现科研潜质与独立科研能力	15%	180
6	论文写作	论文结构、撰写规范性; 文字表达准确、清晰和流畅性; 引文严谨、规范性	10%	70
总体评价			总分	77

注: “分数”栏每项均按百分制整数评分, 各项满分均为 100 分。评分分为四档: 大于等于 90 分为优秀; 大于等于 75 分小于 89 分为良好; 大于等于 60 分小于 74 分为一般; 小于 60 分为差。

对学位论文的学术评语：（请对论文的学术水平、创新性做出简要评述，包括选题意义，文献资料的掌握，论文创新之处，写作规范和逻辑性等。还须明确指出论文中存在的问题和不足之处。可另附页）

论文题目：Microbial lipid production on amino acid-rich wastes

作者姓名：Rasool Kamal

本论文研究了氨基酸及氨基酸混合物对产油酵母油产量的影响。并评估了四种产油酵母利用氨基酸产油的性能。另外发现氨基酸可以促进甘油利用。特别是脯氨酸能显著提高甘油利用及产油率。本研究是有意义的产油价值和现实意义。有利于拓展产油酵母的产物谱。论文写作逻辑性需要进一步加强。章节之间的关联性不强特别清晰。

主要建议如下：

1. 第三章作者比较了产油酵母利用氨基酸的性能。和与标题引用 *Rhodospirillum rubrum* 和第二章的关联是什么？为什么发酵条件有所不同
2. 第四章发现氨基酸混合物能显著促进甘油利用。为什么仅用甘油就能作为底物，甘油和氨基酸的很多。为什么不用这些氨基酸
3. 有脯氨酸促进油脂利用是否也产油酵母有没有效？来验证比例
4. 有品质问题，比如 F447 的引用所有性能都是完美的。难以区分。

是否同意组织学位论文答辩

（请在相应栏内划“√”）

☒ 同意答辩

☐ 修改后答辩

☐ 不同意答辩

## 评审意见英文版

The English version comments to the thesis of

### **Microbial lipid production on amino acid-rich wastes**

This thesis investigate the utilization of amino acids or their mixtures for enhancing the lipid production in oleaginous yeasts, and compared the amino acids assimilation ability of four oleaginous yeasts. It was also found that amino acids, in particular proline improved the glycerol utilization and lipid production, which should expand the substrate spectrum. This study is of important in regard of industrial application and scientific interest. However, the thesis organization can be improved to make the logic clear. The main concerns are listed below:

1. The thesis title showed amino acid-rich wastes, however the author didn't use the real amino acid-rich wastes as feedstocks. I suggest change to 'Microbial lipid production on amino acids'
2. In chapter 3, the author compared the utilization of amino acids in three yeast species. Why the author only show *Rhodospiridium toruloides* in this chapter title? What's the relevance between chapter 2 and 3. I noticed the fermentation conditions were different.
3. In chapter 4, it was found that the amino acid mixture significantly improved the glycerol utilization. Why the author used the lysine as a substrate for lipid production, since several other amino acids such as glycine and glutamine were the most significant used in the amino acids mixtures.
4. It was found the l-proline improved the glycerol utilization and lipid production in *Rhodospiridium toruloides*. How about this effect on other oleaginous yeast? In other words, the generality of l-proline effect in other oleaginous yeasts?
5. There are some typos in the text, for example, all the bars in Fig. 4.7 I are white, which made it impossible to distinguish the data. The first appearance of abbreviation such as SVAA, MIAA and FMAA should full name. please check the main text carefully

## 学术道德评价

（一票否决）

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3	创新成果	论文成果创新性，对学科发展、技术进步、经济建设、国家安全等方面产生的影响和贡献	40%	80
4	基础理论和专门知识	基础理论的宽厚度、坚实度，专门知识的系统性、深入性	10%	80
5	科研能力	论文体现科研潜质与独立科研能力	15%	85
6	论文写作	论文结构、撰写规范性；文字表达准确、清晰和流畅性；引文严谨、规范性	10%	85
总体评价			总分	83

注：“分数”栏每项均按百分制整数评分，各项满分均为100分。评分分为四档：大于等于90分为优秀；大于等于75分小于89分为良好；大于等于60分小于74分为一般；小于60分为差。

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论文题目：Microbial lipid production on amino acid-rich wastes

作者姓名：Rasool Kamal

本论文针对食品废弃物转化为油脂开展了探索性工作。选题具有实用价值和一定创新性。文献综述较完备。实验设计合理。所取得结果具有一定指导意义。论文撰写清晰规范。同意答辩。有以下问题建议供考虑：

1. 论文拟定的三种原料SVAA, MZAA, PMAA引用了文献158-160的数据。但此三篇文献年代较久远。是否反映了现有废弃物实际情况？
2. 如对实际真实样品进行评价。是否需要预处理环节？是否有其他影响成分？应加以探讨。
3. SVAA, MZAA, PMAA组成不同。在对其利用过程中是否对各氨基酸有发酵规律否？可否通过碳源比例混配。得到更合适底物？

是否同意组织学位论文答辩

（请在相应栏内划“√”）

☒ 同意答辩

☐ 修改后答辩

☐ 不同意答辩

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3	创新成果	论文成果创新性，对学科发展、技术进步、经济建设、国家安全等方面产生的影响和贡献	40%	35
4	基础理论和专门知识	基础理论的宽厚度、坚实度，专门知识的系统性、深入性	10%	6
5	科研能力	论文体现科研潜质与独立科研能力	15%	12
6	论文写作	论文结构、撰写规范性；文字表达准确、清晰和流畅性；引文严谨、规范性	10%	4
总体评价			总分	75

注：“分数”栏每项均按百分制整数评分，各项满分均为 100 分。评分分为四档：大于等于 90 分为优秀；大于等于 75 分小于 89 分为良好；大于等于 60 分小于 74 分为一般；小于 60 分为差。

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论文题目：Microbial lipid production on amino acid-rich wastes

作者姓名：Rasool Kamal

- 论文选题有很好的学术意义和应用价值，有一定的创新。1. 问题如下：
1. 论文语法错误较多，需认真修改。(1) 摘要“ATCC 20509”不应斜体；(2) “the conversion of *R. toruloides*”错误，“the amount of lipid”错误，……其它错误见正文。
  2. 所有英文段落应空两个字符。
  3. 每个chapter题目不应单独一页。
  4. 所有Table应用三线表。P37页等。P72等。
  5. P51 “To further”空格
  6. P125 发表文章格式需统一。

是否同意组织学位论文答辩  
(请在相应栏内划“√”)

☐ 同意答辩

☒ 修改后答辩

☐ 不同意答辩

## 学术道德评价

（一票否决）

评价要素	评价意见（请在相应栏内划“√”）
是否存在剽窃他人成果、伪造数据、由他人代写等严重作假行为	<input type="checkbox"/> 是（具体说明存在的问题）
	<input checked="" type="checkbox"/> 否

## 评阅意见

评 价 要 素			权重	具体得分 (百分制)
1	论文选题	选题的理论意义、实用价值	10%	9
2	文献综述	反映该学科及相关领域的前人成果和前沿动态	15%	12
3	创新成果	论文成果创新性，对学科发展、技术进步、经济建设、国家安全等方面产生的影响和贡献	40%	30
4	基础理论和专门知识	基础理论的宽厚度、坚实度，专门知识的系统性、深入性	10%	7
5	科研能力	论文体现科研潜质与独立科研能力	15%	12
6	论文写作	论文结构、撰写规范性；文字表达准确、清晰和流畅性；引文严谨、规范性	10%	9
总体评价			总分	79

注：“分数”栏每项均按百分制整数评分，各项满分均为 100 分。评分分为四档：大于等于 90 分为优秀；大于等于 75 分小于 89 分为良好；大于等于 60 分小于 74 分为一般；小于 60 分为差。

对学位论文的学术评语：（请对论文的学术水平、创新性做出简要评述，包括选题意义，文献资料的掌握，论文创新之处，写作规范和逻辑性等。还须明确指出论文中存在的问题和不足之处。可另附页）

论文题目： **Microbial lipid production on amino acid-rich wastes**

作者姓名： **Rasool Kamal**

In general, the work is focused on the utilization of by-products from meal industrial by using the waste AA inside, which has a good potential in both bio-energy production and environmental application. The essay was well written and organized. Some suggestions and comments are below.

- (1) Some calculation and statistical analysis should be provided. For example, the significant analysis was missed in most of table and figures. The info of lipid yield calculation based on which substrates should also be provided clearly in multi carbon sources experiments.
- (2) The reason for the using of different strains should be clearly expressed. For example Figure 5.1.
- (3) The expression of significant digit in the abstract and content should be consisted.
- (4) Why some AA in table 2.4 and 3.1 were different in amount? And the chromatograms of standard mixture in Figure 2.1 and Figure 4.1 were different in peaks nearby 30 min?
- (5) Some running titles are wrong in page 73-76.

是否同意组织学位论文答辩  
(请在相应栏内划“√”)

☒ 同意答辩

☐ 修改后答辩

☐ 不同意答辩