引用本文

[1]刘春,王显生,麻.大豆种子贮藏蛋白遗传改良研究进展[J].大豆科学,2008,27(05):866-873.[doi:10.11861/j.issn.1000-9841.2008.05.0866]

LIU Chun,WANG Xian-sheng,MA Hao.Genetic Improvement on Soybean Seed Storage Proteins[J].Soybean Science 2008,27(05):866-873.[doi:10.11861/j.issn.1000-9841.2008.05.0866]





# 大豆种子贮藏蛋白遗传改良研究进展(PDF)分享到：

《大豆科学》[ISSN:1000-9841/CN:23-1227/S] 卷：第27卷 期数：2008年05期 页码：866-873 栏目：
出版日期：2008-10-25

**Title:** Genetic Improvement on Soybean Seed Storage Proteins

文章编号： 1000-9841(2008)5-0866-08

作者： 刘春[1;2]；王显生[1]；麻[1]
1南京农业大学大豆研究所，作物遗传与种质创新国家重点实验室，江苏 南京 210095；
2衡阳师范学院生命科学系，湖南 衡阳 421008

**Author(s):** LIU Chun[1;2]; WANG Xian-sheng[1]; MA Hao[1]
1State Key Laboratory of Crop Genetics and Germplasm Enhancement；Soybean Research Instiute，Nanjing Agricultural University，Nanjing 210095,Jiangsu；
2Department of Life Science，Hengyang Normal University，Hengyang 421008,Hunan,China

关键词： 大豆；种子贮藏蛋白；遗传改良；7S和11S；亚基

**Keywords:** Soybean; Seed storage protein; Genetic improvement; 7S and 11S; Subunits

分类号： S565.1

**DOI:** 10.11861/j.issn.1000-9841.2008.05.0866

文献标志码： A

摘要： 大豆种子中含有40%左右的蛋白质，是世界重要的植物蛋白来源，7S和11S组分是大豆种子贮藏蛋白的主要构成部分，约占70%。7S组分主要由α'、α、β亚基构成，这三个亚基分别由$Cgy_1$、$Cgy_2$和$Cgy_3$基因控制；11S组分由酸性多肽链和碱性多肽链组成的$A_{1a}B_{1b}$、$A_{1b}B_2$、$A_2B_{1a}$、$A_3B_4$和$A_5A_4B_3$等五个亚基构成。这些亚基分别由$Gy_1$、$Gy_2$、$Gy_3$、$Gy_4$和$Gy_5$基因控制。大豆种子贮藏蛋白亚基变异类型丰富，除对大豆种质进行筛选外，国外研究者已通过杂交育种和辐射诱变育种培育出了高11S/7S比值的品系。通过外源基因导入和编码大豆贮藏蛋白基因修饰来提高大豆种子蛋白品质的遗传工程方面已经起步。理化诱变也是改良大豆蛋白品质的一条可行途径。所有这些研究对于改良大豆贮藏蛋白的营养价值和加工品质都具有重要意义。

**Abstract:** Soybean seeds are one of the most-important vegetable protein sources because of their high protein content (about 40%).The storage proteins in soybean seeds consist of two major components，7S globulin (α-conglycinin) and 11S globulin

(glycinin), which together account for about 70% of the total seed protein.7S globulin consists of three primary subunits, α', α and β, α', α and β are encoded by $Cgy_1$、$Cgy_2$和$Cgy_3$respectively；11S globulin consists of five major subunits which designated as $A_{1a}B_{1b}$、$A_{1b}B_2$、$A_2B_{1a}$、$A_3B_4$和$A_5A_4B_3$respectively.Each subunit is composed of two parts：an acidic polypeptide and a basic polypeptide, which are linked by a single disulfide bond.The five subunits are encoded by five genes, which are designated as $Gy_1$、$Gy_2$、$Gy_3$、$Gy_4$和$Gy_5$, respectively.There is great genetic diversity of the relative contents of seed storage protein and their subunits in soybean germplasm.In addition to screening soybean germplasm for variation, high 11S/7S ratio lines have been obtained by crossing breeding and radiation induction.The genetic engineering of soybean proteins by introduction of foreign genes into transgenic soybean plants and modification of genes encoding storage proteins of soybeans have been started.Physic-chemic induction is also a feasible method to improve soybean protein quality.All of these are very important to improve the functional and nutritional properties of soybean proteins.

---

参考文献/References:


[1] Osborne T B.The vegetable proteins[M].Longmans, Green and Co.London.1924.

[2]周新安, 盖钧镒, 马育华.大豆种子贮藏蛋白组成及其相关分析[J].大豆科学, 1992,11(3)：191-197.(Zhou X A, Gai J Y, Ma Y H.Study on the components of seed storage protein and their correlations in soybean[J].Soybean Science, 1992,11(3)：191-197.)

[3] Naismith W E F.Ultracentrifuge studies of soya bean protein[J].Biochimica et Biophysica Acta, 1955,16(2)：203-210.

[4] Koshiyama I, Kikuchi M, Harada K,et al.2S globulins of soybean seeds.I.Isolation and characterization of protein components [J].Journal of Agriculture and Food Chemistry, 1981,29(2)：336-340.

[5] Koshiyama I, Kikuchi M, Fukushima D.2S globulins of soybean seeds.II.Physicochemical and biological properties of protease inhibitors in 2S globulins[J].Journal of Agriculture and Food Chemistry,1981, 29(2)：340-343.

[6]丁勇.大豆种子贮藏蛋白遗传工程研究[J].中国生物工程杂志, 1995,15 (5)：7-11 (Ding Y.Study on genetic engineering of soybean seed storage protein[J].China Biotechnology, 1995, 15 (5)：7-11.)

[7]王金龙, 陈存来.大豆种子贮藏蛋白组分11S/7S研究概况[J].山东农业科学, 1998,36 (1)：48-50.(Wang J L, Chen C L.Study advance on 11S/7S in soybean seed storage protein[J].Shandong Agricultural Science, 1998,36 (1)：48-50.)

[8]刘志胜, 李里特, 辰巳英三.大豆蛋白营养品质和生理功能研究进展[J].大豆科学, 2000, 19（3）：263-268.(Liu Z S, Li L T, Tatsumi.Nutritional quality and physiological functions of soy protein[J].Soybean Science, 2000,19 (3)：263-268.)

[9]Thanh V H, Shibasaki K.Heterogeneity of beta-conglycinin[M].Biochimica et Biophysica Acta, 1976, 469(3)：326-338.

[10]Fontes E P B, Moreira M A, Davies C S,et al.Urea-elicited changes in relative electrophoretic mobility of certain glycinin and (conglycinin subunits[J].Plant Physiology, 1984,76(3)：840-842.

[11] Hill J E, Breidenbach R.W.Protein of soybean seeds II.Accumulation of the major protein components during seed development and maturation[J].Plant Physiology, 1974,53(3)：747-751.

[12]Tsukada Y K, Kitamura K, Harada K,et al.Genetic analysis of subunits of two major storage protein (β-conglycinin and glycinin) in soybean seeds[J].Japanese Journal of Breeding, 1986,36(3)：390-400.

[13] Thanh V H, Shibasaki K.β-conglycinin from soybean proteins.Isolation and immunological and physicochemical properties of the monomeric forms[J].Biochimica et Biophysica Acta, 1977,490(3)：370.

[14] Thanh V H, Shibasaki K.Major proteins of soybean seeds.Subunit structure of β-conglycinin[J].Journal of Agriculture and Food Chemistry, 1978,26(3)：692-695.

[15]李里特.大豆加工与利用[M].北京：化学工业出版社, 2003:111-112(LiL T.Soybean processing and utilization[M].Beijing：Chemical Industry Press, 2003:111-112.

[16] Badley R A, Atkinson D, Hauser H,et al.The structure, physical and chemical properties of the soybean protein glycinin [J].Biochimica et Biophysica Acta, 1975,412(2)：214-228.

[17]Scallon B, Thanh V H, Floener L A,et al.Identification and characterization of DNA clones encoding group-glycinin subunits [J].Theoretical and Applied Genetics, 1985,70(3)：510-519.

[18] Kitamura K, Davies C S, Nielsen N C.Inheritance of alleles for $Cgy_1$ and $Gy_4$?storage protein genes in soybean[J].Theoretical and Applied Genetics, 1984,68(2): 253-357.
[19] Davies C S, Coates B, Nielsen.Inheretance and biochemical analysis of four electrophoretic variants of β-conglycinin from soybean[J].Theoretical and Applied Genetics, 1985,71(3): 351-358.
[20] Hayashi M, Harada K, Kitamura K.Characterization of a 7S globulin-dificient mutant of soybean (Glycine max(L.) Merri.) [J].Molecular And General Genetics, 1998,258(2): 208-214.
[21] Tumer N, Richter J D, Nielsen N C.Structural characterization of the glycinin precursors[J].Journal of Biological Chemistry, 1982,257(8): 4016-4018.
[22]Cho T J, Davies C S, Nielsen N C.Inheritance and organization of glycinin genes in soybean[J].The Plant Cell, 1989,1(3): 329-337.
[23]Kaizuma N.A mutant line on 11S globulin subunits induced with gamma-ray irradiation[J].Japanese Journal of Breeding, 1990,40(5): 505-506.
[24] Kitamura K, Ishimoto M, Kaizuma K.Genetic relationships among genes for the subunits of soybean 11S globulin [J].Japanese Journal of Breeding, 1993, 43[Suppl 2]:159-163.
[25]Teraishi K, Takahashi M, Hajika M,et al.Suppression of soybean β-conglycinin genes by a dominant gene, Scg-1 [J].Theoretical and Applied Genetics, 2001,103(8): 1266-1272.
[26]Saio K, Watanabe T.Differences in functional properties of 7S and 11S soybean protein[J].Texture Studies, 1991,9(2): 211-241.
[27] Kitamura K, Norihiko K.Mutant strains with low level of subunits of 7S globulin in soybean seeds[J].Japanese Journal of Breeding, 1981,31(4): 353-359.
[28]徐豹, 邹淑华, 庄炳昌,等.野生大豆(G.soja)种子贮藏蛋白组份11S/7S的研究[J].作物学报, 1990,16 (8): 235-241.(Xu B, Zou S H, Zhuang B C,et al.Study on seed storage protein component 11S/7S of wild soybean (G.soja)[J].Acta Agronomica Sinica, 1990,16(8): 235-241.)
[29]黄丽华, 麻浩, 王显生,等.大豆种子贮藏蛋白11S和7S组分的研究[J].中国油料作物学报, 2003,25(3): 20-23.(Huang L H, Ma H, Wang X S, et al.Study on 11S and 7S fraction of seed storage protein in soybean[J].Chinese Journal of Oil Crop Sciences, 2003,25(3): 20-23.)
[30]王丽侠, 邹顺堂, 付翠真, 等.大豆种子贮藏蛋白11S与7S组份的研究[J].中国粮油学报, 2004,19（4）: 53-57.(Wang L X, Guo S T, Fu C Z,et al.The analysis of 11S/7S in soybean storage protein［J］.Journal of the Chinese Cereals and Oils Association, 2004,19 (4): 53-57.)?
[31]关荣霞, 常汝镇, 邱丽娟, 等.栽培大豆蛋白亚基11S/7S组成及过敏蛋白缺失分析[J].作物学报, 2004,30 (11):1076-1079.(Guan R X, Chang R Z, Qiu L J,et al.Analysis of protein subunit 7S/11S constitution and allergen lacking of soybean [Glycine max(L.) Merrill] cultivars[J].Acta Agronomica Sinica, 2004,30 (11): 1076-1079.)
[32]麻浩, 王显生, 刘春,等.706份中国大豆种质贮藏蛋白7S和11S组分及其亚基相对含量的研究[J].大豆科学, 2006,25 (1): 11-17.(Ma H, Wang X S, Liu C,et al.The content variation of 7S, 11S globulins and their subunits of seed storage protein of 706 Chinese soybean germplasm[J].Soybean Science, 2006,25 (1): 11-17.)
[33]Ogawa T, Tayama E, Kitamura K, et al.Genetic Improvement of seed storage proteins using three variant alleles of 7S globulin subunits in soybean (Glycine max L.)[J].Japanese Journal of Breeding, 1989,39(2): 137-147.
?[34]Takahashi K, Banba H, Kikuchi A.Ito M.An induced mutant line lacking the α-subunit of β-conglycinin in soybean (Glycine max(L.) Merri.)[J].Breeding Science, 1994,46(1): 65-66.
[35]胡志昂, 王洪新, 赵述文, 等.栽培大豆和野生大豆（Glycine soja）种子蛋白的变异[J].大豆科学, 1986, 5 (3): 205-210.(Hu Z A, Wang H X, Zhao S W,et al.Variation of seed protein for cultivated and wild soybean(Glycine soja)[J].Soybean Science, 1986,5 (3): 205-210.)
[36] Staswick P E, Hermodson M A, Nielsen N C.Idendification of the acidic and basic subunit complex of glycinin[J].Journal of Biological Chemistry, 1981,256(16): 8752-8755.
[37]Harada K, Toyokawa Y,Kitamura K.Genetic analysis of the most acidic 11S globulin subunit and related characters in soybean seeds[J].Japanese Journal of Breeding, 1983, 33(1): 23-30.
[38] Harada K, Barker S, Goldberg R.Soybean β-conglycinin genes are clustered in several DNA regions and are regulated by transcriptional and posttranscriptional processes[J].The Plant Cell, 1989,1(4): 415-425.
[39]Hajika M, Takahashi M, Sakai S,et al.A new genotype of 7S globulin (β-conglycinin) detected in wild soybean (Glycine soja) [J].Breeding Science, 1996,46(4): 385-386.

[40]Odanaka H, Kaizuma N.Mutants on soybean storage proteins induced with γ-ray irradiation[J].Japanese Journal of Breeding,1989,[Suppl 1], 39：430-431.?
[41] Takahashi M, Uematsu Y, Kashiwaba K,et al.Accumulation of high -levels of free-amino acids in soybean seeds through integration of mutation conferring seed protein deficiency[J].Planta, 2003,217(4)：577-586.
[42] Kim C S.Enhanced emulsifying activity of soybean proglycinin modified by protein engineering[J].Food Science and Biotechnology, 1999,8 (3)：184-188.
[43]孙英.转gaga1基因大豆的培育及初步鉴定[D] 南京农业大学, 2003:33-43.(Sun Y.Transformation of soybean with gene gaga1 and primary characterization of transgenic plants[D].Nanjing Agricultural University, 2003:33-43.)
[44] Bray E A, Naito S, Pan N S,et al.Expression of the β-subunit of β-conglycinin in seeds of transgenic plants[D].Planta, 1987,172(3)：364-370.
[45] Lawton M A, Tierney M A.Expression of a soybean β-conglycinin gene under the control of the Cauliflower Mosaic Virus 35S and 19S promoters in transformed petunia tissues[J].Plant Molecular Biology, 1987,9(3)：315-325.
[46]Altenbach S B, Pearson K W, Meeker G,et al.Enhancement of the methionine content of seed proteins by the expression of a chimeric gene encoding a methionine-rich protein in transgenic plants[J].Plant Molecular Biology, 1989, 13(5)：513-522.
[47]Clercq A D, Vandewiele M, Rycke R D.Expression and processing of an Arabidopsis 2S albumin in transgenic tobacco [J].Molecular Journal of General Genetics, 1990,221(3)：306-314.
[48] Clercq A D, Vandewiele M, Damme J V,et al.Stable accumulation of modified 2S albumin seed storage proteins with higher methionine contents in transgenic plants[J].Plant Physiology, 1990,94(3)：970-979.
[49] Yagasaki K, Kaizuma N, Kitamura K.Inheritance of glycinin subunits and characterization of glycinin molecules lacking the subunits in soybean (Glycine max(L.)Merri.)[J].Breeding Science, 1996,46(1)：11-15.
[50]Utsumi S.Improvement of nutritional value and functional properties of soybean proteins and protein engineering[J].New Food Industry, 1990,32 (5)：71-84.
[51] Wright D J.The seed globulins part II.In "Developments in Food Proteins"[M].London：Elsevier Applied Science Publishers, 1998:119-127.
[52]Nakamura T, Utsumi S, Mori T.Effects of temperature on the different stages in thermal gelling of glycinin[J].Journal of Agriculture and Food Chemistry, 1985,33 (6)：1201-1203.
[53] Kato A, Yutani K.Correlation of surface properties with conformational stabilities of wild-type and six mutant tryptophan synthase α-subunit substituted at the same position［J］.Protein engineering, 1988,2(2)：153-156.
[54]王大成.蛋白质工程[M].北京:化学工业出版社, 2002:94-105.(Wang D C.Protein engineering[M].Beijing：Chemical Industry Press, 2002:94-105.)
[55]王培英, 许德春, 郭玉虹,等.人工诱变改良大豆品质的研究[J].核农学报, 2000, 14 (1)：21-23.(Wang P Y, Xu D C, Guo Y H, et al.Induced mutation for soybean quality[J].Acta Agriculturae Nucleatae Sinica, 2000,14 (1)：21-23.)

相似文献/References:

[1]刘章雄,李卫东,孙石,等.1983～2010年北京大豆育成品种的亲本地理来源及其遗传贡献[J].大豆科学,2013,32(01):1.[doi:10.3969/j.issn.1000-9841.2013.01.002]
LIU Zhang-xiong,LI Wei-dong,SUN Shi,et al.Geographical Sources of Germplasm and Their Nuclear Contribution to Soybean Cultivars Released during 1983 to 2010 in Beijing[J].Soybean Science,2013,32(05):1.[doi:10.3969/j.issn.1000-9841.2013.01.002]
[2]李彩云,余永亮,杨红旗,等.大豆脂质转运蛋白基因GmLTP3的特征分析[J].大豆科学,2013,32(01):8.[doi:10.3969/j.issn.1000-9841.2013.01.003]
LI Cai-yun,YU Yong-liang,YANG Hong-qi,et al.Characteristics of a Lipid-transfer Protein Gene GmLTP3 in Glycine max [J].Soybean Science,2013,32(05):8.[doi:10.3969/j.issn.1000-9841.2013.01.003]
[3]王明霞,崔晓霞,薛晨晨,等.大豆耐盐基因GmHAL3a的克隆及RNAi载体的构建[J].大豆科学,2013,32(01):12.[doi:10.3969/j.issn.1000-9841.2013.01.004]
WANG Ming-xia,CUI Xiao-xia,XUE Chen-chen,et al.Cloning of Halotolerance 3 Gene and Construction of Its RNAi Vector in Soybean (Glycine max)[J].Soybean Science,2013,32(05):12.[doi:10.3969/j.issn.1000-9841.2013.01.004]
[4]张春宝,李玉秋,彭宝,等.线粒体ISSR与SCAR标记鉴定大豆细胞质雄性不育系与保持系[J].大豆科学,2013,32(01):19.[doi:10.3969/j.issn.1000-9841.2013.01.005]
ZHANG Chun-bao,LI Yu-qiu,PENG Bao,et al.Identification of Soybean Cytoplasmic Male Sterile Line and Maintainer Line with Mitochondrial ISSR and SCAR Markers[J].Soybean Science,2013,32(05):19.[doi:10.3969/j.issn.1000-

9841.2013.01.005]
[5]卢清瑶,赵琳,李冬梅,等.RAV基因对拟南芥和大豆不定芽再生的影响[J].大豆科学,2013,32(01):23.[doi:10.3969/j.issn.1000-9841.2013.01.006]
LU Qing-yao,ZHAO Lin,LI Dong-mei,et al.Effects of RAV gene on Shoot Regeneration of Arabidopsis and Soybean [J].Soybean Science,2013,32(05):23.[doi:10.3969/j.issn.1000-9841.2013.01.006]
[6]杜景红,刘丽君.大豆fad3c基因沉默载体的构建[J].大豆科学,2013,32(01):28.[doi:10.3969/j.issn.1000-9841.2013.01.007]
DU Jing-hong,LIU Li-jun.Construction of fad3c Gene Silencing Vector in Soybean[J].Soybean Science,2013,32(05):28. [doi:10.3969/j.issn.1000-9841.2013.01.007]
[7]张力伟,樊颖伦,牛腾飞,等.大豆"冀黄13"突变体筛选及突变体库的建立[J].大豆科学,2013,32(01):33.[doi:10.3969/j.issn.1000-9841.2013.01.008]
ZHANG Li-wei,FAN Ying-lun,NIU Teng-fei?,et al.Screening of Mutants and Construction of Mutant Population for Soybean Cultivar "Jihuang13"[J].Soybean Science,2013,32(05):33.[doi:10.3969/j.issn.1000-9841.2013.01.008]
[8]盖江南,张彬彬,吴瑶,等.大豆不定胚悬浮培养基因型筛选及基因枪遗传转化的研究[J].大豆科学,2013,32(01):38. [doi:10.3969/j.issn.1000-9841.2013.01.009]
GAI Jiang-nan,ZHANG Bin-bin,WU Yao,et al.Screening of Soybean Genotypes Suitable for Suspension Culture with Adventitious Embryos and Genetic Transformation by Particle Bombardment[J].Soybean Science,2013,32(05):38. [doi:10.3969/j.issn.1000-9841.2013.01.009]
[9]王鹏飞,刘丽君,唐晓飞,等.适于体细胞胚发生的大豆基因型筛选[J].大豆科学,2013,32(01):43.[doi:10.3969/j.issn.1000-9841.2013.01.010]
WANG Peng-fei,LIU Li-jun,TANG Xiao-fei,et al.Screening of Soybean Genotypes Suitable for Somatic Embryogenesis [J].Soybean Science,2013,32(05):43.[doi:10.3969/j.issn.1000-9841.2013.01.010]
[10]刘德兴,年海,杨存义,等.耐酸铝大豆品种资源的筛选与鉴定[J].大豆科学,2013,32(01):46.[doi:10.3969/j.issn.1000-9841.2013.01.011]
LIU De-xing,NIAN Hai,YANG Cun-yi,et al.Screening and Identifying Soybean Germplasm Tolerant to Acid Aluminum [J].Soybean Science,2013,32(05):46.[doi:10.3969/j.issn.1000-9841.2013.01.011]

**备注/Memo:** 基金项目：引进国际先进农业技术计划（948计划）资助项目(2001-207)；高等学校学科创新引智计划资助。
作者简介：刘春(1978-)，男，硕士，讲师，现主要从事大豆品质改良与利用方面的研究。