Preference Study of Rice Obtained from Some Areas Which Represent the High Yielding Varieties of Rice in Indonesia

Hanifah Nuryani Lioe[1], Munyatul Islamiah[1] and Anton Apriyantono[1,2]
[1]*Department of Food Science and Technology, Faculty of Agricultural Engineering and Technology, Bogor Agricultural University, IPB Darmaga Campus, PO Box 220, Bogor, West Java, Indonesia*
[2]*Department of Food Technology, Universitas Bakrie, Jakarta, Indonesia*

Keywords: Cooked Rice, Consumer Preference, Descriptive Sensory Analysis, Rice Preference, Sensory Characteristic.

Abstract: Indonesia is an agricultural country. One of the most important agriculture is rice which is a staple food for people of Indonesia. Every province in Indonesia has a difference of high yielding variety of rice. It relates to the acceptance and preference of consumers which are influenced by social environment and origin of area. The preference of consumers and the palatability determine quality and sensory characteristics of rice. This study aimed to characterize the sensorial quality of 4 varieties of rice, obtained from West Sumatra, West Java, South Sulawesi and Papua, and to identify preference of consumers to the cooked rice. Descriptive sensory analysis was performed by 8 trained panelists who used 14 descriptors to quantitatively describe the sensory characteristics of four rices. Descriptive data were visualized by spider web and were analyzed by two-way ANOVA and Tukey's Multiple Range Test if significantly different across attribute ($p<0,05$). In parallel, the preference of consumers of rice on these rice was expressed on a nine-point hedonic scale. To understand consumers' responses further, the preference ratings were also analyzed by one-way ANOVA and Duncan's Multiple Range Test if significantly different across sample ($p<0,05$). The result showed that preference of consumers of West Java and South Sulawesi were influenced by taste and texture of cooked rice. They disliked taste and texture of cooked rice from Cisokan. The preference of this consumers was taste and texture of cooked rice from Ciliwung. On the other hand, the consumers of West Sumatra disliked taste, aroma, and texture of cooked rice from Ciliwung. The consumers of Papua (reprenseting West Papua and Papua Provinces) did not have specific sensory characteristic in consumed cooked rice. However, they disliked the aroma of cooked rice from Ciherang.

1 INTRODUCTION

Rice is the main source of nutrition and energy for more than 90% of Indonesia's population. The consumer preferences to rice have become researchers' attention. However, research on rice preferences for major consumers in Indonesia has not been done in depth, even though it has been known publicly that each region in Indonesia has different preferences on rice.

Consumer preference and rice palatability characteristics determined the quality of cooked rice (Tao et al. 2019, Okpiaifo et al. 2020). Sensory evaluations carried out on the cooked rice can be influenced by the different population in different area or region (Aoki et al. 2017). The sensory evaluation plays an important role to reveal consumer preferences. Therefore, in this present study, sensory evaluation was conducted to know the consumer preference from 4 main regions which are yielding main varieties of rice in Indonesia.

Each region in Indonesia may have different rice varieties produced. This depends on the climate, topography, soil conditions, and different cultural backgrounds for each region (Yuliawan and Handoko 2016, Agustiani et al. 2018, Rumanti et al. 2018). These factors lead to the existence of superior rice varieties which are favorite varieties of rice for farmers and consumers in the area. The diversity of rice varieties can be seen from each region, for example Cianjur variety in West Java, Solok variety in West Sumatra, etc. This variety of rice may have different compositions, especially the amylose-amylopectin content of the rice (Tao et al. 2019). The difference in composition is greatly influenced by conditions of agricultural land, rice genetics,

Lioe, H., Islamiah, M. and Apriyantono, A.
Preference Study of Rice Obtained from Some Areas Which Represent the High Yielding Varieties of Rice in Indonesia.
DOI: 10.5220/0009978200002833
In *Proceedings of the 2nd SEAFAST International Seminar (2nd SIS 2019) - Facing Future Challenges: Sustainable Food Safety, Quality and Nutrition*, pages 57-62
ISBN: 978-989-758-466-4

fertilization, the environment where it grows and the climate. Comparison between amylose and amylopectin is used as the basis in determining the quality of taste and texture of rice. Amylose content is positively correlated with the level of softness, adhesiveness, color and gloss (Haryadi, 2008). This is because amylose has a greater retrogadation ability (Pratiwi, 2017). According to Haryadi (2008), rice with high amylose content produces dry and dry rice, whereas rice with low amylose content produces sticky and soft rice. In addition, another factor that determines the diversity of rice varieties is aroma and taste (flavor characteristics). Aroma is produced from volatile components released from rice (Zeng et al., 2008), meanwhile taste is associated to non-volatile components (Lioe et al. 2010).

Research on rice preferences in terms of consumer preferences in different area is a very important problem considering that Indonesia is a country that consists of various ethnicities and cultures so that the types of favorite rices may also be different. This research can later be used as a reference or consideration for rice plant breeders in assembling new high yielding varieties in terms of community preferences or preferences related to the culture of an area so that it can be consumed and liked by the people in the area. The aim of this study was to identify the preferences of people from West Sumatra, West Java, South Sulawesi, and Papua (representing West Papua and Papua Provinces) for the four superior rice varieties evaluated, namely Cisokan, Ciherang, Ciliwung, and Membramo, and to determine the relationship between consumer preferences and description of sensory attributes of rice from the different varieties.

2 MATERIAL AND METHODE

2.1 Materials

The materials used in this study were superior rice varieties which were widely consumed in the 4 regions of Indonesia: West Sumatra, West Java, South Sulawesi and Papua. These varieties were Cisokan variety (origin from West Sumatra Province), Ciherang variety (from West Java Province), Ciliwung variety (from South Sulawesi Province), and Membramo variety (from West Papua and Papua Provinces) obtained from the Indonesian Center for Rice Research, Sukamandi, West Java. The four varieties were harvested from February to March 2011. Grain drying under sun was carried out until the grain moisture content was 14% wb. As much as 300 grams of grains from each variety were processed with Satake Rice Husker which separated rice and skin. Then, 200 grams of rice and skins were scrubbed for 3.5 min by using Satake Polisher to obtain head rice and broken rice. The polish degree used was 90%. The polished rice used in the sensory evaluation consisted of the mixture of head rice and broken rice. During the research, rice was placed in an airtight plastic container covered with black plastic. Then rice was stored in a refrigerator at 9-11˚C. Polished rice needed during this research was 6.5 kg for each variety.

The chemicals used were standards of flavor (2-acetyl pyridine, acetoin, vanillin, diacetyl, pandan flavor, 5-methyl-2-furfural, and sugar lactone) in liquid form. Vanilin and pandan flavor compounds were from Sensient Technologies Indonesia Co., meanwhile 5-methyl-2-furfural, 2-acetyl pyridine, acetoin, diacetyl, and sugar lactone compounds were obtained from Ogawa Indonesia Co. The standards were stored in small bottles (with a capacity of 10 mL) and placed in a refrigerator at temperatures of 0-4˚C. Equipments needed included a set of four rice cookers (Miyako, MCM-509, Indonesia), aluminum foil, measuring cup, glasswares, a small container for sensory testing.

2.2 Determining Rice Samples

A literature study was carried out by reviewing various literatures on superior varieties of rice that were widely produced and consumed in West Sumatra, West Java, South Sulawesi, and Papua. The rice samples used in this study were as follows (Puslitbangtan, 2010):

- Cisokan: unfluffier (not pulen) rice texture, amylose content of 26%, glycemic index at 34, known as lowland rice with an altitude of 500 m above sea level.
- Ciherang: fluffier (pulen) rice texture, amylose content of 23%, glycemic index at 54.9. It was planted in lowland irrigated rice fields up to 500 m above sea level. High productivity with quality and taste of rice was equivalent to IR64.
- Ciliwung: fluffier rice texture, amylose content of 22%, glycemic index at 86. It was planted in low-irrigated irrigated land up to 550 m above sea level.
- Membramo: fluffier rice texture, amylose content of 19%. It was either planted on irrigated land less than 550 m above sea level or more than.

2.3 Rice Cooking Method

Cooking of rice was done in the same way for the four superior varieties, its method included the rice cooker type (1.8 L capacity), the ratio of rice to water, as well as the way of rice washing until the way of rice being served. Rice was cooked using a rice cooker. Before cooking, the rice to be cooked was weighed at 0.38 kg. Rice was then 4-5 times washed with tap water until the washing water became considerably clear. Washed and drained rice was put into a rice cooker pan. Then 670 mL of tap water was added. The pan was put into the rice cooker. The rice cooker was closed, but previously covered with aluminum foil, then closed properly. After the rice has been cooked, it was let for 15 minutes in the cooker. The rice was then stirred evenly. The four samples were presented simultaneously in a hot state in a container that was closed using aluminum foil.

2.4 Sensory Analysis by Quantitative Descriptive Analysis (QDA) and Hedonic Test

The evaluation method used in this study was QDA to determine the sensory characteristics of a sample. Trained panelists who have passed the selection and training phase evaluated the samples. The panel selection phase included the pre-screening stage, identification of basic tastes and aromas, triangle tests, ranking tests, and personal interviews. After the panel candidates passed the selection stage, training was then conducted to produce a group of panelists which had a consistent result in evaluating the sensory attributes of sample (Drake & Civille, 2003).

Consumer preference testing was done using a hedonic rating by a panel of Bogor Agriculture University students come from West Sumatra (34 persons), West Java (45 persons), South Sulawesi (42 persons), Papua (30 persons). The hedonic test was done by rating the attributes of taste, aroma and texture. The range of hedonic scale is between 1 (extremely like) to 9 (extremely dislike).

Focus group discussion (FGD) were conducted before and after QDA testing. The FGD prior to the training was conducted to determine the attributes of taste, aroma, and texture that would be used in the training process. The FGD after the training was conducted so that panelist sensitivity in detecting the presence of taste, aroma, and texture attributes in the sample was higher. The results obtained from the FGD was used in the QDA analysis.

The reference concentrations for aroma and taste obtained during training was processed using the Stephen equation (Meilgaard et al. 1999), then the equation was reduced to a logarithmic equation. This was done to get the reference concentration used in QDA analysis. In contrast, for texture attributes where the reference values were following Meullenet et al. (1999).

QDA analysis was conducted to determine the intensity of sensory attributes (taste, aroma and texture) on each rice sample tested. The attribute intensity of the samples was carried out using an unstructured line scale. Unstructured scale consisted of lines along the 15 cm with a border mark at both ends. On the scale of the line also given 2 assistance lines as a reference. Each sample of rice was placed in a special container that has a three-digit code. The sample was presented under the same controlled conditions as normal consumer conditions. Time between two testings (from one sample to another) were given at a time interval of 20 min. During the time, the panelists were given drinking water to neutralize the senses if for taste and texture testings or were given coffee powder if for aroma testing. Evaluation of the intensity of each attribute of a sample was carried out triplo. The QDA was carried out by 8 trained panelists who assessed the four rice samples in a time. QDA data were processed using ANOVA and multivariate analyses, namely principal component analysis (PCA) using Unscrambler version 9.2 (Camo, Norway).

3 RESULTS AND DISCUSSION

3.1 Classification of Rice Varieties on Attributes of Taste, Aroma and Texture

The spider web diagram in Figure 1 shows the four varieties of rice were described as having sweet, salty and gurih (like umami) tastes; also vanilla, sweet, pandan leaf, nutty and buttery aromas. The four varieties had different rice characteristics, especially for the attributes of adhesiveness, coarseness, toothpull, sweet and nutty aromas. Cisokan had the lowest adhesiveness but Ciherang had the highest adhesiveness, Membramo had the highest toothpull, Ciliwung had the highest sweetness.

Mapping the taste, aroma, and texture attributes results in three different groups which described 82% of variance in the data (Figure 2). The first group contained the varieties of Membramo and Ciherang which were described with the adhesive attributes of the sample on the lips which were low, sweet taste

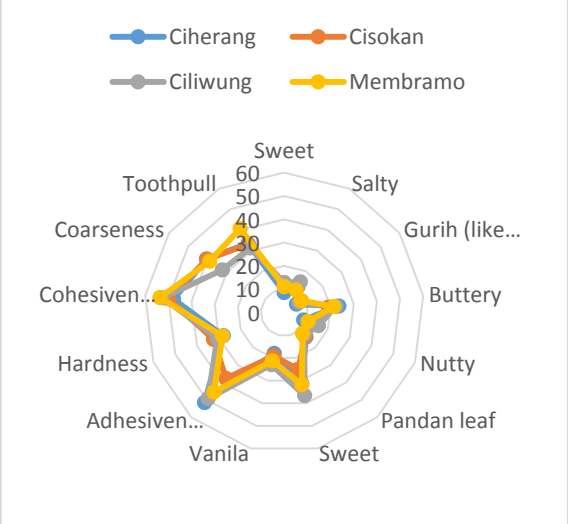

Figure 1: Spider web diagram of flavour characteristics (taste, aroma and texture) of four varieties of Indonesian rice. Taste: sweet, salty, gurih; Aroma: buttery, nutty, pandan leaf, sweet, vanilla; Texture: adhesiveness, hardness, cohesiveness, coarseness, toothpull.

and high taste. The second group was the Ciliwung variety which was characterized by the highest aroma, sweet, vanilla, nutty, and saltiness. The third group contained Cisokan variety characterized by attributes of particle size (coarseness) and sample hardness when chewed.

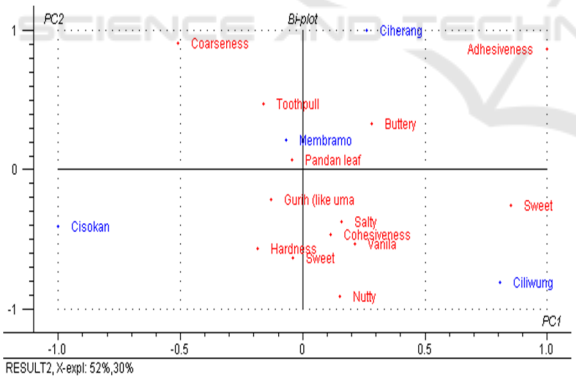

Figure 2: PCA of flavour characteristics of four varieties of Indonesian rice.

3.2 Consumer Preferences for Aroma, Taste, and Texture Attributes

PCA analysis was conducted to find out how the grouping of consumers' preferences of each region towards rice from superior varieties of rice. The consumer preference towards aroma of the rice was relatively similar, the same case of the taste, except for the consumer originally from South Sulawesi. The preference towards kepulenan (toothpull) of the rice was relatively different among the variety as well as the consumer groups, as presented in Table 1.

Preference of consumers of West Java and South Sulawesi were influenced by taste and texture of cooked rice. The preference of the consumers was taste and texture of cooked rice from Ciliwung. They disliked taste and texture of cooked rice from Cisokan. On the other hand, the consumers of West Sumatra disliked taste, aroma, and texture of cooked rice from Ciliwung. The consumers of Papua did not have specific sensory characteristic in consumed cooked rice. However, they disliked the aroma of cooked rice from Ciherang.

Table 1: Consumer preference of four varieties of Indonesian rice assessed by four groups of consumers based on their origin.

Rice*	West Sumatera			West Java			South Sulawesi			Papua**		
	e***	f	g	e	f	g	e	f	g	e	f	g
A	3.5	4.1	4.6	3.3	4.0	4.5	3.4	4.2	4.6	4.1	3.9	3.5
B	3.3	4.0	3.9	3.7	4.6	5.3	4.1	5.1	5.3	3.8	3.9	4.2
C	4.0	4.5	5.3	3.9	4.0	4.0	3.9	3.6	3.6	3.8	3.9	4.0
D	3.3	4.3	3.7	3.8	4.4	4.5	4.0	4.2	4.1	4.1	3.8	3.8

*A: Ciherang; B: Cisokan; C: Ciliwung; D: Membramo
**West Papua and Papua Provinces
***e = aroma, f = taste, g = kepulenan. Kepulenan is someting to do with the texture of rice, the feel of softness when the rice is chewed. The range of hedonic scale is between 1 (extremely like) to 9 (extremely dislike).

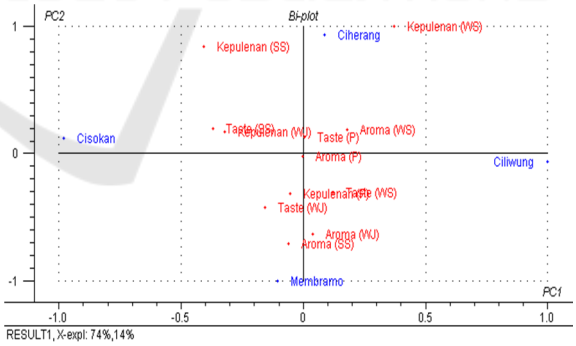

Figure 3: PCA of preference of four groups of consumers (WS: West Sumatera; WJ: West Java; SS: South Sulawesi; P: Papua) towards aroma, taste and kepulenan (softness during chewing) of four varieties of Indonesian rice.

Mapping consumer preferences by PCA is shown in Figure 3, the PCA result described 88% of variance. In overall, the consumer preference towards the four varieties of the rice were different from each other (Figure 3). Consumers of West Java and South Sulawesi preferred the taste and texture of rice from the varieties of Ciherang and Membramo. The

consumers rated the rice aroma attribute of Cisokan variety with low preference. Consumers of West Sumatra consumers had a low preference for taste, aroma, and texture attributes of Ciliwung variety.

3.3 The Relationship between Descriptive Analysis and Preference Test

The regression of West Java consumer preferences for the rice aroma attribute obtained by PLS analysis gave the equation: Y = -2.02545 + 0.02959 Sweet + 0.06018 Nutty + 0.03096 Vanilla + 0.15595 Pandan + 0.05602 Buttery, R^2 = 0.9925. Based on the highest regression coefficient, it can be seen that the aroma that most influencing the preferences of West Java consumers was the aroma of pandan (+: positive correlation). Positive correlation shows the higher the value of the regression coefficient, the higher the consumer preference. The regression of the West Java consumer preferences for rice taste attributes was: Y = 3.72343 + 0.03651 Sweet - 0.08397 Salty + 0.1459 Tasty, R^2 = 0.8237. The taste attributes of rice that most influencing the preferences were savory (+) and salty (-). The regression for rice texture attributes was: Y = -1.08993 - 0.02675 Adhesives + 0.02491 Hardness - 0.04067 Cohesive + 0.05317 Roughness + 0.0117 Toothpull + 0.10851 Particle Size, R^2 = 0.9999. The texture attributes of rice that most influencing the preferences of West Java consumers were the roughness and particle size or coarseness (+), cohesiveness (-).

The regression of West Sumatra consumer preferences for rice aroma attributes obtained by PLS analysis gave the equation: Y = 3.30119 + 0.01801 Sweet + 0.06278 Salty - 0.01081 Savory R^2 = 0.3941. The taste attribute of rice that most influencing the preferences of West Sumatra consumers was the saltiness (-). The regression for rice texture attributes gave the equation: Y = 13,465 + 0.0391 Adhesives + 0.0335 Hardness - 0.0212 Cohesive - 0.0839 Roughness - 0.085 Toothpull - 0.0871 Size Particle, R^2 = 0.9997. Rice textures that most influencing West Sumatra consumer preferences were hardness and adhesiveness (+) as well as particle size (-).

The regression of South Sulawesi consumer preferences for the aroma of rice was: Y = 6.28051 - 0.01826 Sweet + 0.0348 Nutty + 0.03264 Vanilla - 0.06495 Pandan - 0.09552 Buttery, R^2 = 0.9926. The aroma attributes that most influencing the preferences of South Sulawesi consumers were vanilla and nutty aroma (+); pandan and buttery (-). The regression for rice taste attributes produced the equation: Y = 5.24163 + 0.02047 Sweet - 0.18608 Salty + 0.14613 Savory, R^2 = 0.3984. The taste attributes of rice that most influencing the preferences of South Sulawesi consumers were savory (+) and salty (-). The regression for rice texture attributes was: Y = -1,14137 - 0.02918 Adhesives + 0.02703 Hardness - 0.09234 Cohesive + 0.07943 Roughness - 0,00065 Toothpull + 0.14553 Particle Size, R^2 = 0.9999. The texture attributes of rice that most influencing the preferences of South Sulawesi consumers were the roughness and particle size (+), cohesive (-).

Consumer Preferences of Papua had the regression equation: Y = 5.28598 + 0.00487 Sweet - 0.04405 Nutty -0.00848 Vanilla -0.111188 Pandan + 0.033 Buttery, R^2 = 0.9930. The aroma attributes that most influencing the preferences of Papuan consumers were buttery (+) and pandan (-). The regression for rice taste attributes was: Y = 6.18152 + 0.19746 Sweet -0.16674 Salty -0.3095 Savory, R^2 = 0.9296. The taste attributes of rice that most influencing the preferences of Papua consumers were sweet (+) and savory and salty (-). The regression of Papuan consumer preferences for rice texture attributes was: Y = 0.159004 -0.013738 Adhesives + 0.053877 Hardness + 0.024992 Cohesiveness - 0.017795 Roughness -0.007644 Toothpull + 0,044906 Particle Size, R^2 = 0.9998. The texture attributes of rice that most influencing the preferences of Papuan consumers were hardness and particle size (+).

4 CONCLUSIONS

Rice from different rice varieties had different specific characteristics. The results of qualitative descriptive analysis on rice samples produced 14 attributes, namely the attributes of sweet, salty, and gurih (savory) taste; vanilla, nutty, buttery, sweet, and pandan aroma; attributes of adhesiveness, hardness, cohesiveness, roughness, toothpull, and the size of rice particles when chewed. The flavor characteristics of the four varieties of rice were different to each other, especially for the attributes of adhesiveness, coarseness, toothpull, sweet and nutty aromas.

REFERENCES

Agustiani, N., Deng, N., Edreira, J. I. R., Girsang, S. S., Syafruddin, Sitaresmi, T., Pasuquin, J. M. C., Agus, F., Grassini, P., 2018. Simulating rice and maize yield potential in the humid tropical environtment of Indonesia. *European Journal of Agronomy 101: 10–19*.

Aoki, K., Akai, K., Ujiie, K., 2017. A choice experiment to compare preferences for rice in Thailand and Japan: The impact of origin, sustainability, and taste. *Food Quality and Preference 56: 274–284*.

Drake, M. A., Civille, G. V., 2003. Flavor Lexicons. Comprehensive Reviews in *Food Science and Food Safety 2: 33–40*.

Haryadi. 2008. *Teknologi Pengolahan Beras*. *Gajah Mada University Press. Yogyakarta*.

Lioe, H. N., Selamat, J., Yasuda, M., 2010. Soy Sauce and Its Umami Taste: A Link from the Past to Current Situation. *Journal of Food Science 75(3): 71–76*.

Meilgaard, M., Civille, G. V., Carr, T. B., 1999. *Sensory Evaluation Techniques*. *CRC Press, 3rd Edition. New York. 387 p*.

Meullenet, J. F. C., Sitakalin, C., Marks, B. P., 1999. Predicting of rice texture by spectral stress strain analysis: a novel technique for treating instrumental extrusion data used for predicting sensory texture profiles. *Journal of Texture Studies 30: 435–450*.

Okpiaifo, G., Durant-Morant, A., West, G. H., Nalley, L. L., Nayga Jr, R. M., Wailes, E. J., 2020. Consumers' preferences for sustainable rice practices in Nigeria. *Global Food Security 24: 1–11*.

Pratiwi, M., Faridah, D. N., Lioe, H. N., 2017. Structural changes to starch after acid hydrolysis, debranching, autoclaving-cooling cycles, and heat moisture treatment (HMT): A review. Starch 68: 1–13.

[PUSLITBANGTAN] Pusat Penelitian dan Pengembangan Tanaman Pangan, 2007. Deskripsi padi varietas ciherang, ciliwung, cisokan, membramo. http://pangan.litbang.deptan.go.id. [16 Agustus 2011].

Rumanti, I. A., Hairmansis, A., Nugraha, Y., Nafisah, Susanto, U., Wardana, P., Subandiono, R. E., Zaini, Z., Sembiring, H., Khan, N. I., Singh, R. K., Johnson, D. E., Stuart, A. M., Kato, Y., 2018. Development of tolerant rice varieties for stress-prone ecosystems in the coastaldeltas of Indonesia. *Fields Crops Research 223: 75–82*.

Tao, K., Yu, W., Prakash, S., Gilbert, R. G., 2019. High-amylose rice: Starch molecule structural features controlling cooked rice texture and preference. *Carbohydrate Polymers 219: 251–260*.

Yuliawan, T., Handoko, I., 2016. The effect of temperature rise to rice crop yield in Indonesia eses Shierary Rice model with geographical information system (GIS) feature. *Procedia Enviromental Sciences 33: 214–220*.

Zeng, Z., Zhang, H., Zhang, T., Chen, J. Y., 2008. Flavor volatiles in three rice cultivars with low level of digestible protein during cooking. *Cereal Chemistry 85: 689–695*.