Journal of Global Biosciences
Peer Reviewed, Refereed, Open-Access Journal
ISSN 2320-1355
Volume 11, Number 11, 2022, pp. 9551-9561
Website: www.mutagens.co.in
URL: www.mutagens.co.in/jgb/vol.11/111105.pdf

SCAN ME

Research Paper

LYCOPENE CONTENT OF THREE TOMATO VARIETIES MARKETED IN MBUJIMAYI, DEMOCRATIC REPUBLIC OF CONGO

Kadima, Lufuluabo C.[1], Kalanda, Kankenza L.[2], Mbuyi, Tshilumba C.[3], Mwembo, Tambwe A.[4, 5] and Katenga, Bosunga G.[6]

[1]Faculty of Medicine,
Official University of Mbujimayi, Democratic Republic of Congo
[2]Biology Department,
Institut Supérieur Pédagogique de Mbujimayi, Democratic Republic of Congo
[3]Faculty of Agricultural Sciences,
Official University of Mbujimayi, Democratic Republic of Congo
[4]School of Public Health of the University of Lubumbashi,
Democratic Republic of Congo
[5]Faculty of Medicine,
University of Lubumbashi, Democratic Republic of Congo
[6]Department of Gynecology-Obstetrics,
University of Kisangani, Democratic Republic of Congo.

Abstract

Tomatoes are one of the richest foods in lycopene. Lycopene has been reported to improve sperm count, motility and concentration. Knowledge of the lycopene content in the tomato varieties in Mbujimayi could be an avenue to be exploited to treat cases of male infertility in Mbujimayi. To determine the lycopene content in the three varieties of tomatoes marketed in Mbujimayi, Democratic Republic of Congo. This was a descriptive cross-sectional study conducted from August 5 to 10, 2022 in which the lycopene content of the three tomato varieties (*Lycopersicum cerasiforme* var. floradade; *Lycopersicum esculentum* var. romance and lycopersicum var. topiva) was determined by spectrophotometry. The **BECKMANN DU-64, UV- VISIBLE AUXILA BSL, Markham, Chinese-made spectrophotometer in 2014 was used for this purpose**. The *Lycopersicum cerasiforme* var.floradade variety has a higher lycopene content compared to other tomatoes grown near water sources. The difference is statistically significant with O.R = 3.94 [0.91-16.93]. The weight to lycopene content ratio is 12.31g/1.23mg/g for *Lycopersicum cerasiforme* var. floradade; 37.16g/2.44mg/g *Lycopersicum cerasiforme* var. topiva and 37.75g/ 2.60mg/g for *Lycopersicum esculentum* romance. Tomatoes marketed in Mbujimayi in the Democratic Republic of Congo contain lycopene, although at different levels.

The varieties *Lycopersicum cerasiforme* var. topiva and *Lycopersicum esculentum* romance have a higher content. The tomato diet can certainly contribute to the improvement of male reproductive health.
Key words: Lycopene, tomato varieties, Mbujimayi, DR Congo.

INTRODUCTION

The tomato is a fruit of the Solanaceae family which contains lycopene and other minerals; hence the scientific name, Lycopersicum. This genus contains two botanical species that are cultivated in DR Congo: *Lycopersicum esculentum* (the large tomato) and *Lycopersicum cerasiforme* (the small tomato). Each of these two species has several cultivated varieties, commonly called cultivars. Cultivated mainly for its culinary use, the tomato is a fruit originating from the valleys of Mexico.

In the Democratic Republic of Congo, several varieties of *Lycopersicum esculentum* (calinago, caracoli, caraibo, carioca, coeur de boeuf, Diana, T12, Tropic, T26, Grandi, Heinz) are cultivated. In Kasai Oriental and neighboring territories, the following three varieties are marketed: :

- *Lycopersicum esculentum var. romance (large tomato)*
- *Lycopersicum cerasiforme var. floradade (small round tomato)*
- *Lycopersicum cerasiforme var. topiva (small elongated tomato)* [16].

Several studies have shown the importance of a diet rich in fruits and specifically in tomatoes, which, in addition to vitamins and minerals, contains the carotenoid (lycopene). This yellow, orange or bright red pigment, which gives this color to tomato fruits, is a natural compound found in fruits such as tomatoes, watermelons, grapefruits and others [2].

Although it can be found in different fruits, tomato products contain the highest amounts of lycopene and are considered its most important sources in a diet [1,3].

Nowadays, lycopene is a powerful anti-oxidant because of its protective property of the human body against damage caused by free radicals that can damage DNA and other cellular structures.

This beneficial action for the body helps it to delay the aging of cells, prevent the occurrence of certain diseases such as: skin cancer, prostate cancer and improves fertility [2]. Regarding male infertility resulting in oligospermia (low concentration of spermatozoa in the ejaculate), insufficient motility of spermatozoa with morphological

defects or all **three**, lycopene is known to improve sperm quality and is therefore a fertilizer [2].

Since these three varieties have elements of difference from each other, we think that the lycopene content would not be the same that it is necessary to carry out this study.

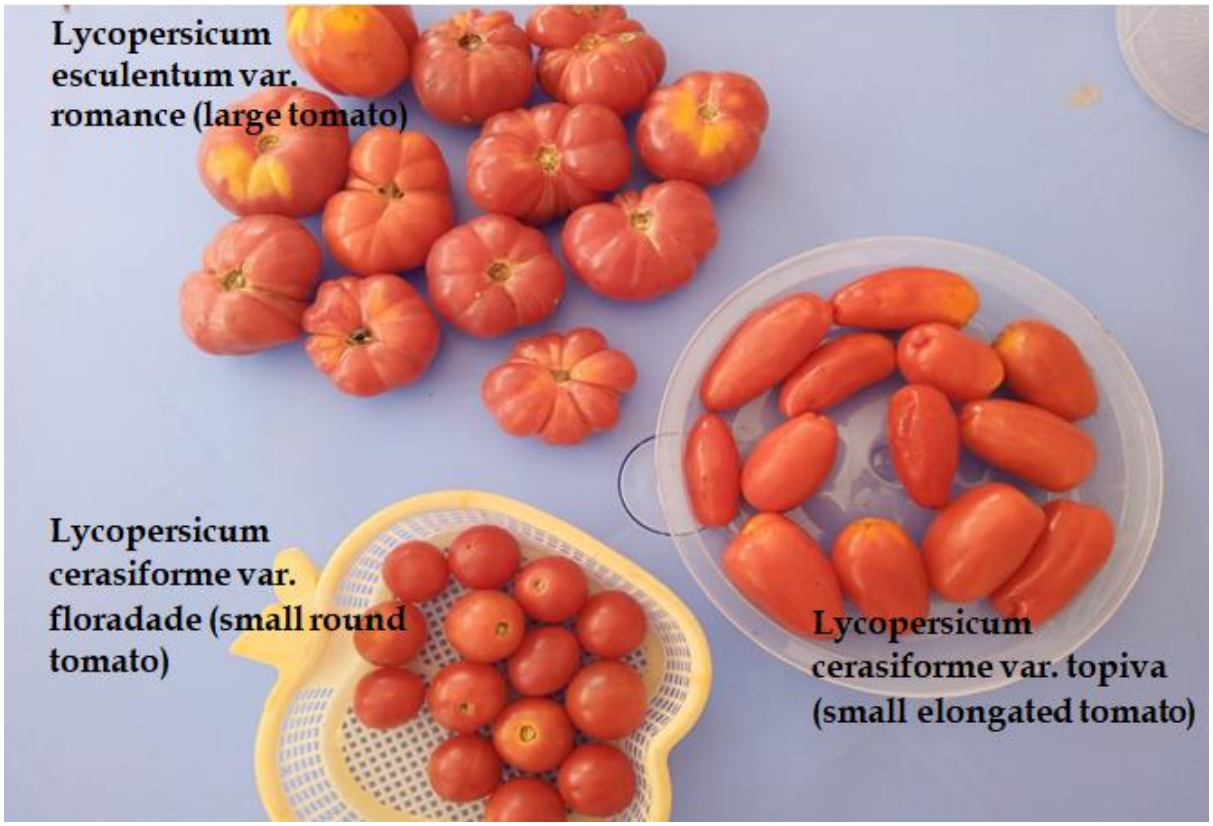
II. MATERIALS AND METHODS

2.1. Material

2.1.1. Plant material

Three varieties of tomato fruits grown in Kasai Oriental and in the villages of the neighboring Lomami Province were purchased at the central market of Bakwadianga in Mbujimayi, which receives the majority of food produced in the neighboring territories [16]. These are:

- *Lycopersicum cerasiforme var. floradade (small round tomato)*
- *Lycopersicum cerasiforme var. topiva (small elongated tomato)*
- *Lycopersicum esculentum var. romance (large tomato)*



Source : Photograph by Dr KADIMA LUFULUABO Célestin

Figure I: Three varieties of tomatoes sold in the market of Mbujimayi, Democratic Republic of Congo

The conservation was made with the help of cold accumulators, housed in an isothermal box and brought directly to the Airport of Mbujimayi a few minutes from the boarding for the city of Lubumbashi, to the Center of Agro-Food Research in order to proceed to the chemical analysis of these tomatoes fruits. Note that it is a trip of one hour and thirty minutes.

Once at the Agri-Food Research Center, CRAA, each fruit per tomato variety was weighed. Then, the tomatoes were dried at 60° C for 48 hours, then crushed. A small quantity, 0.1 gram of the powder from each tomato was taken and mixed in 10 ml of solution (50 ml of hexane, 50 ml of acetone and 1 ml of ethanol). The mixture was stirred for 10 minutes and then centrifuged at 5000 rpm for 15 minutes. One milliliter of the organic phase was extracted and diluted in 10 ml of hexane and placed in a cell. The absorbance was measured at 472 nm (nanometer), and the lycopene content was calculated according to the formula below [4] :

$$C(igIg) = \frac{Abs_{472} \times Fd \times 10^6 \times V}{3450 \times 100 \times D}$$

Caption:

Fd: dilution factor

V: volume of the extraction solvent

P : Weight of the test sample

3450 : extinction coefficient of hexane

Study Type: This is a descriptive cross-sectional study based on the spectrophotometric determination of fruit tomatoes marketed in Mbujimayi.

Selection Criteria: Any lot of ripe fruit tomatoes, in good condition and declared grown on the soil of Kasai Oriental or its surroundings and sold at the Bakwadianga market in Mbujimayi,

Exclusion Criteria: Any tomato declared of unknown origin by the seller, unripe or rotten.

Statistical analysis: Statistical analyses were performed by Microsoft Excel 2010 of the Microsoft Office system of Microsoft Corporation for the calculation of the mean. Epi-info, version 3.5.1 of 2008 were used to calculate the Odds Ratio.

III. RESULTS

Table I. Distribution of tomato varieties according to villages of origin

Village of origin	**Variety *Lycopersicum esculentum* var. romance**	**Variety *Lycopersicum cerasiform* var. floradade**	**Variety *Lycopersicum cerasiforme* var. topiva**	**TOTAL**
1. Ngandajika	15	12	11	38 (12.7%)
2. Luputa/Mwene-Ditu	20	31	22	73 (24.3%)
3. Lukalaba	35	22	28	85 (28.3%)
4. Kabeya-Kamuanga/Mabaya	17	27	19	63 (21.0%)
5. Katanda-Nkwadi	13	08	20	41 (13.7%)
TOTAL	100	100	100	300 (100%)

Table I shows that the majority of tomatoes sold at the Bakwadianga market came from Lukalaba in Kasai Oriental 85 tomatoes or 28.3%, from Luputa and Mwene-Ditu in the neighboring province of Lomami 73 tomatoes or 24.3% and from Kabeya-Kamwanga/Mabaya 63 tomatoes or 21.0% in Kasai Oriental.

Table II. Distribution of tomato varieties according to the types of cultivation fields

Field categories	**Variety *Lycopersicum esculentum* var. romance**	**Variety *Lycopersicum cerasiform* var. floradade**	**Variety *Lycopersicum cerasiforme* var. topiva**	**TOTAL**
Fields near water sources	03	06	02	11 (12.2%)
Fields away from water sources	14	07	09	30 (33.3%)
Imprecise	13	17	19	49 (54.5%)
TOTAL	30	30	30	90 (100%)

Table II shows that in 54.5% of the cases the different batches of tomatoes were mixed so that the sellers did not know the precise source, while in 33.3% of the cases the tomatoes purchased were grown far from waterways.

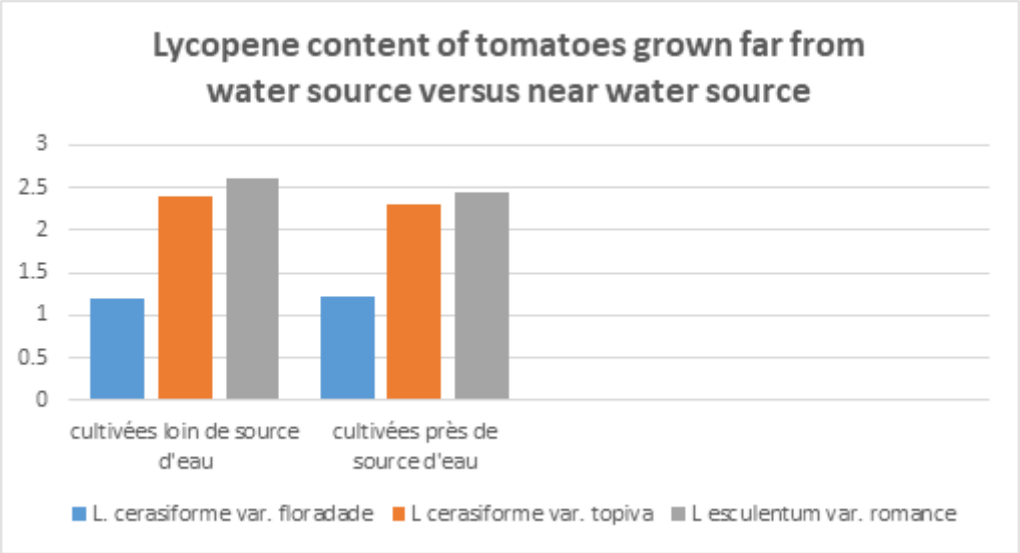


Figure II Lycopene content of tomatoes grown away from water sources versus near water sources.

It was found that for all the three varieties of tomatoes assumed not to have been grown near streams, the variety Lycopersicum ceraciforme var. floradade has a higher lycopene content compared to the other tomatoes grown near water sources. The difference is statistically significant with O.R = 3.94 [0.91-16.93].

Table III. Distribution of lycopene content and weight of tomatoes by variety

	***Lycopersicum esculentum* var. romance**		***Lycopersicum cerasiform* var. floradade**		***Lycopersicum cerasiforme* var. topiva**	
	Weight (g)	**Lycopene content (mg/g)**	**Weight (g)**	**Lycopene content (mg/g)**	**Weight (g)**	**Lycopene content (mg/g)**
No.						
1	12,97	1,23	38,15	2,64	37,17	2,33
2	12,07	1,32	38,11	2,60	36,16	2,31
3	12,79	1,24	38,15	2,64	37,00	2,31
4	12,87	1,23	36,51	2,53	37,07	2,34
5	11,90	1,20	38,15	2,62	38,00	2,35
6	12,99	1,22	37,61	2,55	37,17	2,45
7	11,91	1,23	37,51	2,63	37,16	2,32
8	12,76	1,21	37,11	2,61	36,10	2,31
9	12,57	1,22	38,19	2,64	36,15	2,35
10	11,01	1,20	37,90	2,63	37,24	2,34
11	12,01	1,21	38,15	2,53	37,55	2,47
12	12,03	1,22	36,51	2,62	37,78	2,31
13	12,06	1,31	38,15	2,55	36,98	2,31
14	11,95	1,22	37,61	2,63	36,69	2,34
15	11,75	1,24	37,51	2,61	37,03	2,35
16	12,00	1,23	37,11	2,64	37,89	2,45

17	12,21	1,20	38,19	2,53	37,98	2,32
18	11,87	1,22	36,89	2,62	36,99	2,31
19	11,98	1,23	37,48	2,55	37,84	2,35
20	12,45	1,21	38,77	2,63	37,91	2,31
21	12,87	1,22	39,00	2,61	36,98	2,34
22	11,90	1,24	38,47	2,64	37,55	2,35
23	12,99	1,23	37,98	2,53	37,78	2,45
24	11,91	1,20	38,28	2,62	36,98	2,32
25	12,76	1,22	38,15	2,55	36,69	2,31
26	12,97	1,23	36,51	2,63	37,03	2,41
27	12,07	1,21	38,15	2,61	37,89	2,36
28	12,79	1,22	37,61	2,64	36,16	2,39
29	12,87	1,31	37,51	2,59	37,00	2,43
30	11,90	1,22	37,19	2,62	37,07	2,51
Average	**12,31 g**	1.23 mg/g	37,75 g	**2.60 mg/g**	37,16 g	2.44 mg/g

When analyzing the distribution of tomato varieties according to weight and lycopene content, it appears from this study that on average, the small round tomato (*Lycopersicum cerasiforme* var floridade) weighs 12,31g for a lycopene content of 1,23 mg/g ; the small elongated tomato (*Lycopersicum cerasiforme* var topiva) weighs 37,16g for a lycopene content of 2,44 mg/g and the large tomato (*Lycopersicum esculentum* var romance) weighs 37,75g for a lycopene content of 2,60 mg/g.

IV. DISCUSSION

4.1 From the origin of tomatoes :

All the varieties of tomatoes sold at the central market of the city of Mbujimayi are grown in the neighboring territories of the city, in the Province of Kasai Oriental or in the neighboring Province of Lomami. It should be noted that in both provinces the climate is tropical and humid.

4.2 The impact of cold or heat on the tomato crop :

Climatic conditions can influence the yield of a crop and impact on the quantity and quality of the different substances that constitute it. Tomatoes, although they can be grown in almost any type of soil, perform best when the temperature is between 15 and 25°C. [6,7]

In the center of the Democratic Republic of Congo, where the provinces of Kasai Oriental and Lomami are located, the climate is humid tropical and the average temperature is 25°C. [11].

This could explain the fact that fields very close to water sources have a slightly lower average lycopene content, 1.20 mg/g compared to 1.23 mg/g for tomatoes grown in fields far from water sources.

In a study conducted in the Sahel on the evaluation of the agronomic performance of four varieties of tomatoes in the rainy season, the yield and quality of tomatoes were low [9].

However, the study of Granges A. et al. on grape tomato varieties grown out of soil at low temperature, reported that temperature below 15°C and above 30°C negatively influence the content of lycopene and other carotenoids in the ten tomato varieties studied as well as their agronomic, analytical and taste value [10].

4.3 Lycopene content in different tomato varieties :

Taking into account factors such as climate, water irrigation, soil richness as well as post-harvest storage conditions, the lycopene content in the different varieties of tomatoes marketed in the Bakwadianga market of Mbujimayi in the Province of Kasai Oriental, Democratic Republic of Congo, is far superior to those of other varieties studied in other environments.

In our results, we found the following yields: 1.23 mg/g for the variety *Lycopersicum cerasiforme* var floridade, 2.44 mg/g for the variety *Lycopersicum cerasiforme* var topiva and 2.60 mg/g for *Lycopersicum esculentum* var romance.

In the study of Sawadogo I et al. in Burkina-Faso, lycopene levels were as follows: variety Mongal F1 0.03 mg/g; variety Tropimech 0.06-0.07mg/g; variety Rio grande 0.04 mg/g and variety Royale 0.05mg/g [2].

However, in the study of Erica et al. on the effect of lycopene in tomatoes, its content in fresh tomatoes ranged from 0.88 to 7.74 mg/100 g [1].

In Altess, Climberley, Idool, plaisance and other varieties, although at low temperatures (<15°C) the lycopene content varies between 2 and 6 mg/100 g [10].

CONCLUSION

Tomatoes sold at the market in Mbujimayi, Democratic Republic of Congo, contain lycopene, although at different levels depending on the soil, temperature and/or season.

The varieties *Lycopersicum cerasiforme* var. topiva and *Lycopersicum esculentum* romance have a higher content. Therefore, supplementation of tomatoes in the usual diet can contribute to the improvement of male reproductive health.

Acknowledgements: We thank

1. Mr. Patrick MINGA, agro-chemist from the Centre de Recherche Agro-alimentaire de Lubumbashi in the Democratic Republic of Congo, for having carried out the dosage of lycopene in different varieties of tomatoes.

2. Professor Dr. MUTOMBO KABAMBA André of the Official University of Mbujimayi for the documentation and proofreading of this article.

Conflicts of interest: We do not declare any conflicts of interest.

Authors' contributions

1. KLC: substantial contribution to the design, configuration, acquisition, analysis and interpretation of data
2. KKL: csubstantial contribution to the design, configuration, acquisition, analysis and interpretation of data
3. MTC csubstantial contribution to the design, configuration, acquisition, analysis and interpretation of data
4. KBG Substantial contribution to the design, configuration, acquisition, analysis and interpretation of data and supervision of all work
5 MTA sustantial contribution to data analysis and interpretation

V. BIBLIOGRAPHIC REFERENCES

1. Erica N, Story R., Kapec S, Schwartz, An update on the health effects of tomato lycopene, December 2013, Annual Revue food sci. technol. DOI 101146/annual rev. food 102308124120.

2. Sawadogo I, Moumouni K, Dabire C, Lamoussa P. Study of the influence of processing modes on lycopene contents of four varieties of tomatoes from the northern region of Burkina-Faso, International Journal of Biological and Chemical Sciences, 2015, vol 9 (1) DOI :104314/ijbcs.

3. Luvandu Mbenza M, Nzigula Phasi O, Mwelo Ngobe J, MbinzeKindenge J, Mineral element composition of two varieties of tomatoes consumed in Kinshasa

(*Lycopersicum cerasiforme* and *Lycopersicum esculentum*), International of innovation and scientific research , July 2019, vol 26, no 4, pp 915-925.

4. Benackmoun A., Abbeddou S., Ammouche A., valorization of low quality edible oil with tomato peel was Food chemistry, 2008 n°110, pp.684-690.

5. Lokonga O., Dhed'a D. Okungo L, Oleko W. Etude de la variété phénotypique des fruits de tomates des variétés locales à Kisangani (RD Congo), Mai 2020, Congo sciences, vol 42 n°2, pp 58-70.

6. Lambert L. , Insect control applied to greenhouse tomatoes, Mapaq, Canadian greenhouse tomato crop profile, Pesticide Risk Reduction Program, Pest Management Centre, Agriculture and Agri-Food Canada, August 2006.

7. Polese J.M. La culture de la tomate, éd Artémis, 2007, p 95.

8. Konus M. Analyzing resistance of different Tutaabsoluta (Meyrick) leptoptera, Gelechiidae) strains to abamectininsecticide, Journal of biochemistry-Turk J Biochem, No. 39, vol 3, 2014, pp 291-297.

9. Baragé M., Balla A., Adam T., Dov P. Evaluation of the agronomic performances of four varieties of tomato under Sahelian climate in rainy season, science and technique, natural sciences and agronomy, December, 2008, vol 30, n°2, p49.

10. Granges A., Gillioz M., Augsburger J., and Nicollier F. , Varieties of grape tomatoes grown out of soil at low temperature: agronomic, analytical and taste value, Revue Suisse Vitic. Arboric. Hortic. vol 40 n°4, p223-229.

11. (Anonymous, DRC), Second National Report on the State of Plant Genetic Resources for Food and Agriculture, Kinshasa, June 2009.

12. Ilahy R., Hdider C., Lnucci M., Tlili S., Dalessandro G. , Phytochemical composition and antioxidant activity of high lycopene tomato (*Solanum lycopersicum* L.) cultivars grown in southern Italy, Sci.Hortic., 2011,Vol 127, pp 255-261.

13. Dominguez I., Lafuente M., Hernindez-Muioz P., Gavara R. , Influence of modified atmosphere and ethylene levels on quality attributes off resh tomatoes (*Lycopersicum esculentum* Mill), Food chemistry, 2016, vol 209, pp 2011-2019.

14. (Anonymous, DRC), Guide du vulgarisateur n°3, cultures maraichères, Service National de vulgarisation (SNV) / Ministère de l'Agriculture et du Développement Rural, Projet PNUD/FAO/Zaïre/88/006, Kinshasa, 1993

15. Nathalia Soares, Clara Machado, Bruno Trindade, Ingridy Lima, Etel Gimba, Anderson Teodoro, Christina Takiya, Radovan Borojevic, Lycopene Extracts from Different Tomato-Based Food Products Induce Apoptosis in Cultured Human Primary Prostate Cancer Cells and Regulate TP53, Bax and Bcl-2 Transcript Expression, Asian Pacific-Journal of cancer Prevention, Doi 1022034/APJCP 2017,18,2,339.

16. De Lannoy G., Tomato, in Raemaekers R. H., Agriculture en Afrique tropicale, DGC, I Brussels (Belgium), 2001, pp 508, 511-512.