



## **Dr. Konstantinos V. Kakavas - Lecturer of Chemistry**

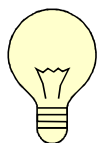
### **Education**

B.Sc. in Chemistry, Aristotelian University of Thessaloniki, Greece

Specialization in Oenology, Aristotelian University of Thessaloniki, Greece

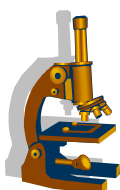
Ph.D. in Human Biochemistry, University of Thessaly, Greece

Full faculty member at University of Thessaly (2009 till today)



### **Research Field of Interest**

1. Environmental Chemistry
2. Public health
3. Genetics
4. Biotechnology and microbiology
5. Chromatographic techniques
6. Essential oils
7. Atomic absorption
8. Wood science and technology



### **Teaching**

### **Undergraduate:**

Chemistry, Environmental chemistry, Quality control, Biopolymers, Biochemistry

### **Graduate:**

Separation Methods

Quality Assurance in Analytical Laboratories - Accreditation Separation Methods - Gas Chromatography mass spectrometry

- Environmental Chemistry-public health.



### **Selected Papers**

1. Marina Chavenetidou, Dimitris Birbilis and **Konstantinos V Kakavas**. Environmental effects on Chestnut wood (*Castanea sativa* Mill.) treated with different surface coatings. 2018 the 6th **International Conference on Mechanical Engineering, Materials Science and Civil Engineering**. China, December 2018 (**Scopus Indexed 2019**). This study investigated the influence of climatic factors on the deterioration of chestnut wood after various manipulations with surface coatings after exposure to ambient conditions for two years. The exposure of chestnut wood surfaces to atmospheric precipitation namely snow, rain and humidity, whether coated or uncoated with hydrophobic substances of low effectiveness led to discolouration due to leaching of water-soluble extracts possessed by the wood. The handling of chestnut wood with surface coatings of hydrophobic protectives (WR) such as teak oil in an organic solvent, epoxy resin based stain, transparent polyurethane varnish with UV protection factor, surface alkyd-based white varnish and exposure to ambient atmospheric conditions showed that discolouration was created due to the leaching of the water-soluble extracts, contained in the chestnut wood for surfaces coated or uncoated with hydrophobic substances of low effectiveness. It was therefore concluded that environmental factors cause discolouration of chestnut wood whether treated or untreated with hydrophobic substances of low effectiveness.
2. **Konstantinos V Kakavas**, Marina Chavenetidou and Dimitris Birbilis. Chemical Properties of Greek Stump Chestnut (*Castanea sativa* Mill.). **Natural Products Chemistry & Research**. **2018**, 6:4 This paper deals with the investigation of chemical properties (electrical conductivity, pH, buffer capacity, minerals) of the species *Castanea sativa* Mill. The quantitative determination of the extracts soluble in hot water and dichloromethane was conducted using a Soxhlet device and according to the American Standards ASTM D 1110-84 and ASTM D 1108-84, respectively. The results showed that Greek Chestnut is rich in nutrients and organic chemical compounds, which can have pharmaceutical applications, and can be used in food technology, cosmetics, natural health or skin care products.

This is the first attempt to record the chemical characteristics of Greek chestnut. DOI: 10.4172/2329-6836.1000331.

3. Dimitris Birbilis, **Konstantinos Kakavas** and Marina Chavenetidou. Macroscopic and microscopic observations of chestnut wood with ring shakes. Growth parameters as indicators of ring shake's occurrence and development of statistical model to predict shake's presence before trees felling. **Eur. J. Wood Prod.** **2018**. DOI 10.1007/s00107-017-1258-8. This work includes observations on chestnut logs at woodcutting areas, measurements of some growth characteristics and observations under microscope of chestnut wood cross sections with ring shakes. Some types of ring shakes were developed in logs with abnormalities, such as forking, double-pith, burls, pith eccentricity and elongated cross sections. The ring shake defect mainly occurred on logs from older trees with large diameters coming from orchards. On logs coming from coppice forests, where young chestnut trees were cut without reaching large diameter, ring shake rarely (and only on logs from trees cut after two rotations) occurred. Ring shakes rarely occur on juvenile wood. They usually occur on adult wood from logs of tree's base. A prognostic statistical model based on logistic regression was developed giving success of up to 80% using age and diameter as estimators. <https://link.springer.com/article/10.1007/s00107-017-1258-8>.
4. **Konstantinos Kakavas**, Marina Chavenetidou and Dimitris Birbilis. Effect of ring shakes on mechanical properties of chestnut wood from a Greek coppice forest. **The Forestry Chronicle.** **2018**, Vol. 94, No 1 - Effect of ring shakes on mechanical properties of chestnut wood from a Greek coppice forest by measurements of several mechanical and physical properties were carried out to detect possible variations between ring shaken and non-ring shaken logs or between different areas of wood from the same log. Mature wood from the ring shake area had lower axial compression and hardness strength compared to mature wood away from ring shakes. Wood from ring shakes area had lower tangential swelling and precisely at the position of the shakes, the wood had a higher coefficient of anisotropy than the surrounding wood. The juvenile wood's density from the ring shaken logs was higher compared to that of mature wood, as well as proportional limit and hardness strength. <http://pubs.cif-ifc.org/doi/abs/10.5558/tfc2018-008>.
5. D. Angelousis, **K. Kakavas**. Smoked Greek mark spirit with different wood types. **Patent GR** 20,160,100,303 December **2017**.
6. T. Tsioukas, D. Birbilis, S. Karastergiou, **K. Kakavas**. «Determining the bending and tensile strength of impregnated with rapeseed oil European beech (*Fagus sylvatica*) wood joints glued with PVAc and PU». **Journal of International Scientific Publications. Materials, Methods & Technologies** ISSN 1314-7269, Volume 9, **2015**. The objective of this study was to examine bending and tensile strength of beech wood (*Fagus sylvatica*) joints along with the effect of wood impregnation with rapeseed oil and type of glue (PVA or PU). The wood specimens were impregnated with the empty-cell treatment (Lowry process). Retention of rape oil was about 273 kg/m<sup>3</sup>. Beech wood impregnation led to some reduction of the bending and tensile strength. Bending strength of the specimens reduced from 9,9% up to 25,9% while tensile strength reduced from 19,7 up to 35,2% for joints glued with PVA and from 2,1 up to 16,7% for joints glued with PU. Joints glued with PU had higher bending and tensile strength in most cases. Joints constructed from wood impregnated before mortise and tenon construction had generally higher mechanical strength. Joints constructed from impregnated wood that primarily treated with turpentine, had lower mechanical strength, than non treated with turpentine joints.

7. D. Birbilis, S. Karastergiou, S. Adamopoulos, **K. Kakavas**, T. Tsioukas. «Wood impregnated with hot rape oil and surface treated with turpentine» 25th International Scientific Conference “**New Materials and Technologies in the Function of Wooden Products**”, October **2017**, Zagreb, Croatia. The objective of this study was to examine oil-retention, adsorption, swelling and tensile strength of lap joints of wood treated with hot rape oil. Wood specimens of two species (*Fagus sylvatica* and *Pinus nigra*) were impregnated in a steel vessel using the empty cell process (Lowry method). Several impregnated specimens were additionally surface treated with turpentine. Rape oil retention ranged between 124 and 189 kg/m<sup>3</sup> for pine wood specimens and between 187 and 285 kg/m<sup>3</sup> for beech wood specimens. For both species, the impregnated specimens had an adsorption of about 20%, while the untreated near 60%. Total swelling of specimens was not affected by the impregnation but the rate of swelling was decreased. The impregnated specimens had a little lower tensile strength mostly when glued with polyurethane (PU).
8. **Konstantinos V. Kakavas**, D. Birbilis, T. Tsioukas. «Determining the tensile strength and other properties of European Beech (*Fagus Sylvatica*) wood impregnated with rapeseed oil». *Journal of International Scientific Publications. Materials, Methods & Technologies* ISSN 1314-7269, 2015.
9. Karastergiou, S., Adamopoulos, S., **Kakavas, K.** Properties of black pine (*Pinus nigra* Arn.) wood treated with hot rape oil. **5th RCCWS International Symposium “Wood Structure, Properties and Quality – 2014”**, Mytisch, Russia, September 22–25, 2014. The objective of this study was to examine oil-retention, swelling, adsorption, static bending properties and tensile strength of lap joints of black pine (*Pinus nigra* Arn.) wood treated with hot rape oil. Wood specimens were impregnated in a steel vessel using the empty cell process (Lowry method). Rape oil retention of black pine specimens ranged between 122 and 193 kg/m<sup>3</sup>. Total swelling of specimens was not affected by the impregnation but the rate of swelling was decreased. The impregnated specimens had an adsorption of 21%, while the untreated 75%. The oil heat-treatment process was found to affect the tensile strength of lap joints. The impregnated specimens showed a lower tensile strength of about 10% than the un-treated.
10. **Kakavas V. Konstantinos**, Plageras P, Vlachos A, Papaioannou B.A, Noulas A. «PCR-SSCP: a method for the molecular analysis of genetic diseases. An overview». **Molecular Biotechnology**. [Humana Press, IF 1,859-2005]. Review, **2008** Feb; 38(2): 155-63. Στην παρούσα επιστημονική εργασία γίνεται ενδελεχώς αναφορά για τη χρήση της μεθόδου PCR-SSCP. Περιγράφονται λοιπόν όλες οι συνθήκες τόσο της μεθόδου SSCP όσο και όλων των άλλων μεθόδων και γίνεται αξιολόγηση όλων των μεθόδων ανίχνευσης και ταυτοποίησης των μεταλλάξεων. <http://link.springer.com/content/pdf/10.1007%2Fs12033-007-9006-7>.
11. **Kakavas V. Konstantinos**, Noulas A., Chalkias C., Hatzichristodoulou C., Georgiou I., Georgatsou E. & Bonanou S. «Identification of the Four Commonest  $\beta$ -Globin Gene Mutations in Greek  $\beta$ -Thalassaemic Patients and Carriers by Non-Radioactive PCR-SSCP: Advantages and Limitations of the Method». **Journal of Clinical Laboratory Analysis**. (2006) 20 (1): 1-7[Wiley Scientific Publications, IF 0,842-2005]. Στη προαναφερθείσα εργασία εγκαθιδρύσαμε μια νέα μέθοδο ταυτοποίησης μεταλλάξεων. Ευρέθησαν τα πρότυπα αποδιάταξης προτύπων δειγμάτων τα οποία συγκρίθηκαν με πρότυπα δείγματα. Όλα τα αποτελέσματα που εξάχθηκαν με τη μέθοδο SSCP, επιβεβαιώθηκαν και με την

μέθοδο ARMS. (Published) <http://onlinelibrary.wiley.com/doi/10.1002/jcla.20091/pdf>.

12. **Kakavas V. Konstantinos**, Noulas A., Kanakis I., Bonanou S., Karamanos «Identification of the commonest cystic fibrosis transmembrane regulator gene  $\Delta$ F508 mutation: evaluation of PCR-single strand conformational polymorphism and polyacrylamide gel electrophoresis». **Biomedical Chromatography** 2006 Oct; 20(10):1120-5 [Wiley Scientific Publications, IF 1,218 – 2005]. Στην παρούσα γίνεται συγκριτική μελέτη των μεθόδων της SSCP & PAGE για την ταυτοποίηση της  $\Delta$ F508 μετάλλαξης. Συμπερασματικά καταλήξαμε ότι η καταλληλότερη μέθοδος είναι η PAGE γιατί δίνει πιο ευκρινή αποτελέσματα. (Published October 2006). <http://onlinelibrary.wiley.com/doi/10.1002/bmc.657/pdf>.
13. Papaioannou A, Rigas N, Rigas G, Paliatsos A.G, Nastos P.T, Plageras P, Roupa Z, **Kakavas K.V** and Dovriki E. «Multivariate statistical interpretation of soil quality data in the context of public health». **Fresenius Environmental Bulletin** 2009, 18, 204-212. Σε αυτή τη μελέτη, αναφέρεται η κατανομή των φυσικοχημικών παραμέτρων του εδάφους που συνήθως χρησιμοποιείται στα αναλυτικά βιοχημικά εργαστήρια. Τρεις αντιπροσωπευτικές περιοχές (πεδινή (LL); ημιορεινή (SM); και παραθαλάσσια (C)), 170 περιοχές επιλέχθηκαν και 510 εδαφικά δείγματα συλλέχθηκαν και αναλύθηκαν για περίοδο τριών ετών (2002-2004), στην περιοχή της Λάρισας, Θεσσαλίας στην κεντρική Ελλάδα. (Accepted- October 2008).
14. Papaioannou B.A, Plageras P, Dovriki E, Minas A, Krikelis V, Nastos PTh, **Kakavas V.K** and Paliatsos A. «Groundwater's quality and location of productive activities in the region of Thessaly (Greece)». **Desalination** (2007) 213: 209-217, [Elsevier, IF 0,995-2005]. Στην προαναφερθείσα εργασία περιγράφονται με την παρουσίαση των φυσικών και χημικών παραμέτρων του νερού της Θεσσαλίας, τα δυνητικά προβλήματα που πρόκειται να ενσκήψουν, αλλά και υπάρχοντα προβλήματα μόλυνσης και ερημοποίησης της αναφερθείσας περιοχής. Τέλος προτείνονται τρόποι αντιμετώπισης των προβλημάτων και μέτρα που πρέπει να ληφθούν. (Accepted May 27 2006). [http://ac.els-cdn.com/S0011916407003232/1-s2.0-S0011916407003232-main.pdf?\\_tid=f85b21d0-a5bc-11e2-94c7-00000aacb35e&acdnat=1366024361\\_785222b7904c2a3de01dc543d5a7f306](http://ac.els-cdn.com/S0011916407003232/1-s2.0-S0011916407003232-main.pdf?_tid=f85b21d0-a5bc-11e2-94c7-00000aacb35e&acdnat=1366024361_785222b7904c2a3de01dc543d5a7f306).
15. Papaioannou A, **Kakavas V.K**, Dovriki E., Plageras P, Karamanis I, Papas M, Noulas A., Minas A., Krikelis V., Paliatsos A. «Quality control of ground water of region Thessaly». **Fresenius Environmental Bulletin** (15/9/2006) 15(9a): 1015-1022, [Parlar Scientific Publications, IF 0,509 – 2005]. Στην παρούσα εργασία γίνεται αξιολόγηση κατά το διάστημα 1994-2004 της αστικής και βιομηχανικής επιβάρυνσης των υπόγειων υδάτων και κατ' επέκταση του περιβάλλοντος, από μολυντές όπως τα νιτρικά τα αμμωνιακά, την αγωγιμότητα. Το πρόβλημα εστιάζεται κυρίως στα νιτρικά. (Published September 2006). [http://www.psp-parlar.de/details\\_artikel.asp?table=FEBArtikel&artikel\\_id=1515&jahr=2006](http://www.psp-parlar.de/details_artikel.asp?table=FEBArtikel&artikel_id=1515&jahr=2006).
16. Nastos P.T, Papaioannou A, Paliatsos A.G, **Kakavas V.K**, Plageras P and Dovriki E. «Wet deposition in two Greek sites: Larissa and Athens» **Fresenius Environmental Bulletin**. Accepted June 12 2008. Vol 17/No 10a/2008 – pages 1648-1654 [Parlar Scientific Publications, IF 0,509 – 2005]. Στην παρούσα έρευνα προσδιορίζεται η χημική σύσταση των βρόχινων νερών και συσχετίστηκαν με τις αέριες μάζες σε δύο βιομηχανικές περιοχές της Ελλάδας, την Αθήνα και την Λάρισα, το 2006. Η μελέτη κατέδειξε ότι και στις δύο περιοχές οι αέριες μάζες που έρχονται από το νότο συντελούν στην εξουδετέρωση των οξέων στα βρόχινα νερά με την άμμο από την Σαχάρα και το θαλάσσιο νερό. Vol

17. Papaioannou A, Plageras P, Dovriki E, **Kakavas K**, Nastos P.Th. & Paliatsos A.G. «Quality Control of Drinking Water and Public Health». **WSEAS Transactions on environment and development ISSN 1790-5079 (2006)**. June 2006, 6(2): 845-850. (Συμπεριλαμβάνεται στις βάσεις δεδομένων BIOSIS, COMPENDEX, EMBASE, ECONLIT, FLUIDEX, GEOBASE, INSPECT, OCEANBASE, NAVIGATOR). Στην παρούσα εργασία γίνεται αναφορά στη διακύμανση των φυσικοχημικών και μικροβιολογικών παραμέτρων των πόσιμων νερών της περιοχής της Θεσσαλίας. Επιλέχθηκαν λοιπόν τρεις αντιπροσωπευτικές περιοχές (Λάρισα – Καρδίτσα- & Μαγνησία) και αναλύθηκαν τόσο οι χημικές όσο και οι μικροβιολογικές παράμετροι για την περίοδο 2004-2005. Συμπερασματικά οι φυσικοχημικές παράμετροι είναι μέσα στα φυσιολογικά επίπεδα, σε αντίθεση με τις μικροβιολογικές παραμέτρους που βρέθηκαν εκτός ορίων. (Accepted- June 26 2006).
18. **Konstantinos V. Kakavas**, Iosifidis Stavros. Simultaneous determination of organic acids in wines aged in oak wood (*Quercus spp*) barrels by HPLC. **American Association for science and technology**, 2:6, **2015** ISSN 2375-3803.

### Θ.3. ΣΥΓΓΡΑΦΕΑΣ ΕΡΓΑΣΙΩΝ ΣΥΝΕΔΡΙΩΝ ΠΟΥ ΕΧΟΥΝ ΕΠΙΛΕΓΕΙ ΚΑΙ ΔΗΜΟΣΙΕΥΤΕΙ ΣΕ ΔΙΕΘΝΗ ΑΝΑΓΝΩΡΙΣΜΕΝΑ ΕΠΙΣΤΗΜΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

19. A. Papaioannou, P. Plageras, G. Karamanis, **K. Kakavas** and A. Noulas. “Reference Values on Serum Biochemical Parameters of Greek Individuals”. **Clinica Chimica Acta** **2005**, 355, S375.

### Θ.4. ΣΥΓΓΡΑΦΕΑΣ ΣΕ ΕΠΙΣΤΗΜΟΝΙΚΕΣ ΕΡΓΑΣΙΕΣ ΣΕ ΔΙΕΘΝΗ ΕΠΙΣΤΗΜΟΝΙΚΑ ΣΥΝΕΔΡΙΑ ΜΕ ΣΥΣΤΗΜΑ ΚΡΙΤΩΝ & ΤΗΡΗΣΗ ΠΡΑΚΤΙΚΩΝ ΜΕ ΜΟΡΦΗ ΤΟΜΟΥ/CD και ΕΙΝΑΙ ΚΑΤΑΧΩΡΗΜΕΝΑ ΣΕ ΔΙΕΘΝΕΙΣ ΒΑΣΕΙΣ ΔΕΔΟΜΕΝΩΝ

20. Sergis D., **Kakavas V. Konstantinos**, Birbilis D., Chavenetidou M. Promising, alternative and innovative wood surface sealing with emery dust - first conclusions. The purpose of this study was to investigate the possibility of using emery dust for an alternative industrial use. In the past emery was used as a raw material in brick manufacturing. It's the first attempt to use emery dust as a wood protecting material from humidity and water. In the project, emery dust was used for pre-treating of Abies alba wood. **13<sup>o</sup> Paint Symposium. National Metsovio Polytechnic. Greece. March 2018.**
21. Birbilis D., Karastergiou S., Kakavas K., Tsioukas Th., Kakaras I. Μηχανική αντοχή συνδέσεων ξύλου Μαύρης Πεύκης (*Pinus nigra*) εμποτισμένου με κραμβέλαιο. **17<sup>o</sup> Πανελλήνιο Δασολογικό Συνέδριο. Κεφαλλονιά 2015.**
22. **Kakavas Konstantinos**, Tsiptas Dimitrios, Doulis Andreas. Near non-destructive DNA barcoding

methodology of archaeological wood species identification with RADP-PCR technology from two excavation sites in Greece. 12<sup>th</sup> ICOM-CC **Wet Organic Archaeological Materials (WOAM)** Instabul Turkey, March **2013**.

23. **Konstantinos V. Kakavas**, Dimirtios Birbilis , Dimitrios Tsiptotas. Simultaneous determination of organic acids in wines aged in oak wood (*Quercus spp*) barrels by HPLC. **16<sup>o</sup> Annual Meeting of Prosilva Europe**, Thessaloniki Greece 2013.
24. Αγναντής Χ, Λαχανά Ε, Μακρή Α, Κακάβας Κ. «Διερεύνηση της στάσης των σπουδαστών του ΤΕΙ Λάρισας απέναντι στην αιμοδοσία και οι παράγοντες που επηρέασαν τη διαμόρφωσή της». Ιατρική **2009**.
25. Papaioannou B.A, Plageras P, **Kakavas K**, Dovriki E, Nastos P.Th., Minas A., Krikelis V., and Paliatsos A.G. «Monitoring and control the quality of drinking water, the necessary action for the protection of public health». **Proceedings of the 2006 IASME/WSEAS International Conference on Energy, Environment Ecosystems & Sustainable development, Athens, Greece, July 26-2006** (pp336-341) ISSN 1790-5079. Στην παρούσα εργασία γίνεται αναφορά στη διακύμανση των φυσικοχημικών και μικροβιολογικών παραμέτρων των πόσιμων νερών της περιοχής της Θεσσαλίας (Καρδίτσα – Λάρισα) για την περίοδο 2004 έως 2005. Στην ερμηνεία των αποτελεσμάτων δεν βρέθηκε κάποιος συσχετισμός των δεδομένων για τα προαναφερθέντα έτη. (Published - Accepted- 26/6/2006).
26. Papaioannou A, **Kakavas K**, Plageras P, Minas A, Roupa Z, Nastos P.Th. & Paliatsos A.G. «Multivariate Statistical Interpretation of Physical, Chemical and Microbiological Variables of Potable Water in the Context of Public Health». **5<sup>th</sup> WSEAS Int. Conf. on environment, Ecosystems and development. Tenerife, Spain, December 2007**, (pp347-352). (Συμπεριλαμβάνεται στις βάσεις δεδομένων BIOSIS, COMPENDEX, EMBASE, ECONLIT, FLUIDEX, GEOBASE, INSPECT, OCEANBASE). Στην παρούσα μελέτη τρεις αντιπροσωπευτικές περιοχές, πεδινή, ορεινή και παραθαλάσσια, επιλέχθηκαν για την συλλογή των δειγμάτων νερού, στις περιοχές της Λάρισας, Τρικάλων Καρδίτσας, και Μαγνησίας, της περιοχής Θεσσαλίας της κεντρικής Ελλάδας. Φυσικές, χημικές, και μικροβιολογικές παράμετροι προσδιορίστηκαν και αναλύθηκαν για χρονική περίοδο του έτους 2006. (Accepted- December 2007).
27. Papaioannou A, **Kakavas V.K**, Plageras P, Dovriki E, Minas A, Noulas A. and Paliatsos A.G «Quality control of soils and groundwater of region Thessaly (Greece)». **8<sup>th</sup> International Conference on Protection and restoration of the environment**. Chania, **Greece, July 2006**. Στην συγκεκριμένη μελέτη γίνεται συσχετισμός των υπόγειων υδάτων και των εδαφών για ύπαρξη μόλυνσης από νιτρικά, τοξικότητα Βορίου, άλατα, για την περίοδο 2000 έως 2004, στην περιοχή του νομού Λάρισας. Τέλος η αναδιάταξη των υπαρχόντων καλλιεργειών δυνητικά θα βοηθούσε στην απομάκρυνση της μόλυνσης από τις αναφερθείσες περιοχές.
28. Papaioannou A, Plageras P., Nastos P.Th, Paliatsos A.G, Dovriki E., Roupa Z., **Kakavas V.K** and I. Papas. «Multivariate statistical interpretation of soil physical and chemical data in the context of public health». **Proceedings of International Conference on Environment Management, Engineering Planning and Economics**. Skiathos, Greece, June 24-28, **2007**. Pages 2667-2672. Editors: A. Kungolos, K. Aravosis, A. Karagiannidis, P. Samaras. Στη μελέτη αυτή γίνεται αναφορά για την ποιότητα του εδάφους στην κεντρική Ελλάδα, για την προστασία του περιβάλλοντος, την δημόσια υγεία, αλλά και

τις τακτικές που πρέπει να ακολουθηθούν για τη διάσωση της περιοχής από την μόλυνση. Η μελέτη έγινε την περίοδο 2002 έως 2004 στην περιοχή της Λάρισας στην κεντρική Ελλάδα.

### **Contact**

Dr. Konstantinos V. Kakavas  
Lecturer  
Laboratory of Quality Assurance  
General department  
University of Thessaly, Greece  
Tel: +30 6937711777  
Fax: +30 2410 550705  
Email: kakavas@teilar.gr