



Prof. Dr. Peter F. Surai (Ayr, Scotland, UK)

Qualification: PhD, DSc

Present post: Technical Director, Feed-Food.Ltd
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University education, degrees:

(1973-1978): Kharkov University, Biochemistry B.Sc.(Hons).

- 1983:** PhD, Biochemistry (Ukrainian Poultry Research Institute)
Project: Biochemical and Functional Changes in Turkey Male Tissues and Sperm in Relation to Vitamin A and E Nutrition
- 1991:** DSc. (Doctor of Science) Physiology (Ukrainian Poultry Research Institute)
«Nutritional and Biochemical Aspects of Vitamins in Poultry»
- 1993:** Professor of Human Physiology, awarded by the Kharkiv National Pedagogical University after G.S. Skovoroda, Ukraine
- 2001:** Professor of Nutritional Biochemistry, awarded by the Scottish Agricultural College
- 2005:** Visiting Professor of Nutritional Biochemistry, awarded by the Scottish Agricultural College
- 2005:** Honorary Professor of Nutrition, awarded by the Szent Istvan University, Godolo, Hungary
- 2005:** Honorary Professor of Poultry and Animal Sciences, awarded by Trakia University, Stara Zagora, Bulgaria
- 2005:** Honorary Professor of Evolutionary and Environmental Biology, awarded by University of Glasgow, Scotland, UK
- 2008:** Honorary Professor of Animal and Poultry Sciences, awarded by Sumy National Agrarian University, Sumy, Ukraine
- 2009:** Honorary Professor of Food Technology, Odessa National Academy of Food Technology, Odessa, Ukraine
- 2010:** Foreign Member of Russian Agricultural Academy, Moscow, Russia

Positions held:

- 1983-1986:** Senior Research Scientist, Department of Nutrition, Ukrainian Poultry Research Institute
- 1986-1988:** Head of Reproduction Biology Laboratory, Ukrainian Poultry Research Institute
- 1988-1992:** Leading Research Scientist, Department of Poultry Reproduction, Ukrainian Poultry Research Institute
- 1992-1993:** Head of Laboratory of Biological Active Substances, Poultry Research Institute
- 1993-1997:** Head of Department of Physiology, Biochemistry and Nutrition, Chief of Laboratory of Nutrition and Vitaminology
- 1994-1995:** Visiting Scientist in the Biochemical Sciences Department
The Scottish Agricultural College
- 1997-1999:** Research Fellow at the Department Biochemistry and Nutrition, The Scottish Agricultural College
- 1999-2001:** Research Scientist at the Avian Science Research Centre, The Scottish Agricultural College
- 2001-** Researcher/Adviser at the Avian Science Research Centre, The Scottish Agricultural College
- May 2004:** Head of Antioxidant Research, Alltech (UK) Ltd, Alltech House Ryhall Road, Stamford Lincs PE9 1TZ, UK
- May 2009:** Technical Director, Feed-Food.Ltd 53 Dongola Road, Ayr, KA7 3BN, Scotland, UK
- May 2009-present:**

Membership of societies:

- 1988 to date:** Member of World's Poultry Science Association (WPSA)
1992- 1996: Vice-President of the Ukrainian Branch WPSA
1999 to date: Member of The Oxygen Society
1999 to date: Editorial Advisory Board: Asian-Australian Journal of Animal Sciences
1999 to 2004: Editorial Advisory Board: Pakistan Journal of Nutrition
2003: Editorial Advisory Board: Functional Food & Genomics
2003 to 2010: Member of Council of UK Branch WPSA

Awards:

- 1999:** John Logie Baird Award for Innovation (1999) in the category Academic and Medical Spinouts (for the development of the super egg).
2000: World's Poultry Science Association Award for Research (2000) in recognition of an outstanding contribution to the development of the poultry Industry (antioxidant work). The award is given to one person once in 4 years for the highest achievements in Poultry Sciences
2003: Biographee 7th Edition of Marquis Who's Who in Science and Engineering
2005: Biographee 8th 2005-2006 Edition of Marquis Who's Who in Science and Engineering
2005: Visiting Professorship in Nutritional Biochemistry at the SAC
2005: Honorary Professor of Nutrition, Award at the Szent Istvan University, Godolo, Hungary
2005: Honorary Professor of Evolutionary and Environmental Biology, awarded by University of Glasgow, Scotland, UK
2006: Biographee 9th 2006-2007 Edition of Marquis Who's Who in Science and Engineering
2008: Biographee 10th 2008-2009 Edition of Marquis Who's Who in Science and Engineering
2005: Visiting Professorship in Poultry and Animal Sciences at Trakia University, Stara Zagora, Bulgaria
2008: Honorary Professor of Poultry and Animal Sciences at Sumy National Agrarian University, Sumy, Ukraine
2009: Honorary Professor of Food Technology, Odessa National Academy of Food Technology, Odessa, Ukraine
2010: Foreign Member of Russian Agricultural Academy, Moscow, Russia

Summary of research:

My major research interests have been concerned with aspects of antioxidant and polyunsaturated fatty acid metabolism in relation to poultry nutrition and reproduction. The development of various analytical techniques accompanied those investigations. Five Patents of the Ukraine and 19 Invention certificates of the former Soviet Union protected results of this work.

Initial work centered upon studies of various aspects of vitamins A and E metabolism in a range of male poultry species, in particular the changes that occur during the period of male use for semen collection for artificial insemination. Vitamin E was found in the avian semen for the first time in the form of α -tocopherol and was shown to be localised mainly in the spermatozoa. Its biochemical role was studied. It was proposed that the function of vitamin E was to stabilise spermatozoa membranes. To test this hypothesis the effect of various dietary levels of vitamin E on the biochemical composition and functional properties of spermatozoa was studied. It was shown that cock and turkey spermatozoa with high vitamin E concentrations were more resistant to damaging factors including sperm dilution, storage and deep freezing. An increased vitamin E concentration in the spermatozoa was associated with decreased spermatozoa susceptibility to lipid peroxidation. These results were the first to show that beneficial changes in the antioxidant status of poultry semen could be achieved by supplemental vitamin feeding of the males. Further experiments with sperm obtained from cocks fed different levels of vitamin E and selenium are in progress now. The system of antioxidant defence in the sperm (vitamins E and C, activity of glutathione peroxidase, superoxide dismutase, catalase, accumulation MDA and diene conjugates) are being studied depending on vitamin feeding of males.

During the research in Biochemical Sciences Department, SAC (since 1994) the work has been mainly concentrated on antioxidant systems of the developing chick embryo and avian semen. The idea concerning 3 major levels of antioxidant defence in the cell was developed and the integrated antioxidant system in the avian embryonic tissues and sperm was characterised. In particular, the levels of vitamins

A, E, C and carotenoids in different embryonic tissues during embryogenesis have been studied. It has been shown that vitamin E and carotenoids are accumulated in the embryonic liver during the last week of the development, which is considered as an adaptive mechanism to protect highly unsaturated lipids from peroxidation. Some new features of antioxidant system of the embryonic brain were found. The brain is shown to have very low concentrations of vitamin E and very high levels of ascorbic acid. The distribution of antioxidants and activities of antioxidant enzymes in different regions of the brain have also been studied. The system of antioxidant defence of embryonic brain has been proposed. *In vitro* systems for the investigation of antioxidant properties of different substances have been developed. Essential plant oils and some carotenoids have been tested.

Antioxidant enzymes (Glutathione peroxidase - GSH-Px), Catalase and Superoxide dismutase- SOD) have been studied in embryonic tissues as well. Tissue specific distribution of Se-dependent and Se-independent GSH-Px, Cu-Zn-SOD and Mn-SOD activities have been found. A comparative study of species-specific features in fatty acid and antioxidant composition of avian semen has been conducted. The results from the foregoing investigation may be considered as a biochemical basis for improvements in the technique of artificial insemination of poultry.

The recent research is devoted to polyunsaturated fatty acids (PUFAs) and antioxidants and their role in poultry reproduction. It includes the development of a special diluent with high antioxidant capacity to increase sperm storage efficiency and manipulation of PUFA, vitamin E and selenium in the male diet to increase the sperm membrane fluidity and as a result fertilising capacity of the spermatozoa, including sperm storage and deep freezing. This work is also associated with study of the effect of dietary manipulation of PUFAs and antioxidants (vitamin E, carotenoids and selenium) on the development and functions of the antioxidant system in avian species as well as mechanisms of absorption and delivery natural antioxidants in avian species. The European Patent N97929374.3-2107 "Improvement of male fertility with antioxidants and/or polyunsaturated fatty acids" protected the results of this work. The molecular mechanisms of antioxidant system regulation were studied and antioxidant system modulation by PUFA, vitamins A and E, and carotenoids were elucidated.

As a result of this work nutritive composition of the egg has been significantly improved by enhancing levels of n-3 polyunsaturated fatty acids, vitamin E, lutein and selenium. All 4 nutrients are important players in disease prevention and they are usually deficient in human diet. A designer egg can substantially improve a human diet delivering these important nutrients. The clinical trial with designer eggs, has showed that consumption of designer eggs significantly increase vitamin E, lutein and DHA concentrations in human blood compared to people who were eating table eggs. At the same time cholesterol level in the blood did not change in control or experimental group which means that consumption of an egg a day is safe.

A comparative study of egg composition of chicken, turkey, duck, goose as well as from wild and captive other avian species has been initiated. It has been shown that eggs from wild geese and pheasants contained much higher proportions of n-3 fatty acids as well as vitamin E and carotenoids compared to captive/housed birds. The same was found comparing wild and captive partridges and American Kestrels. This rises the question concerning adequacy of lipid and vitamin nutrition of these birds. It has also been found that in egg yolk from free range chickens the proportion of n-3 fatty acids and levels of carotenoids were also significantly higher compared to commercial chickens. Therefore these findings are important step in improving lipid and antioxidant composition of chicken eggs obtained from breeders rearing on commercial diets. This could improve chicken hatchability and their viability in early post-natal development.

Biological roles of carotenoids in avian embryo development have been studied and their antioxidant protective effects have been shown. Carotenoid discrimination by avian embryo was found and existence of lutein/zeaxanthin-binding protein has been suggested.

Roles of selenium and its central role in antioxidant defences has been studied. The development of Se-enriched functional food was a priority area for the last few years and Se-enriched eggs are produced in more than 25 countries worldwide.

My recent research work has been devoted to understanding molecular mechanisms of stresses in animal production and designing effective ways of fighting stresses by nutritional means.

For the last 15 years I have been extensively lecturing in area of natural antioxidants in more than 70 countries world-wide.

For the last two years I spent a lot of time visiting poultry production units in Ukraine and Russia and helping them to improve efficiency of egg and meat production.

Research publications:

I have 707 research publications, including 129 papers in peer-reviewed Journals (in English), 142 papers in peer-reviewed Journals (in Russian), five American Patents, one Canadian and one European Patent, five Patents of the Ukraine and 19 Invention certificates of the former USSR and 10 books.

Publications in peer-reviewed Journals (in English):

1. OCHKUR S., KOPEICKA E., SURAI P., GRISHCHENKO V. (1994) The influence of cryopreservation on parameters of energetic metabolism and motility of fowl spermatozoa. *Cryobiology*, **31**: 239-244
2. DORMAN D., DEANS S., NOBLE R., SURAI P. (1995) Evaluation in vitro of plant essential oils as natural antioxidants. *Journal of Essential Oil Research*, **7**: 645-651.
3. SURAI P., WISHART G. (1996) Poultry AI Technology in the countries of the former USSR. *World's Poultry Science Journal*, **52**: 27-43.
4. SURAI P., NOBLE R., SPEAKE B. (1996) Tissue-specific differences in antioxidant distribution and susceptibility to lipid peroxidation during development of the chick embryo. *Biochem. Biophys. Acta*, **1304**: 1-10.
5. GAAL T., VAJDOVICH P., SPEAKE B., NOBLE R., SURAI P. AND MEZES M. (1996) Ageing and lipid peroxidation. *Hungarian Veterinary Journal*, **51**: 165-169.
6. GAAL T., SPEAKE B., MEZES M., NOBLE R., SURAI P., VAJDOVICH P. (1997) Antioxidant parameters and ageing in some animal species. *Comparative Haematology International*, **6**: 208-213.
7. SURAI P., GAAL T., NOBLE R., SPEAKE B. (1997) The relationship between α -tocopherol content of the yolk and its accumulation in the tissues of the newly hatched chick. *Journal of the Science of Food and Agriculture*, **75**: 212-216.
8. SURAI P., KUTZ E., WISHART G., NOBLE R. and SPEAKE B. (1997) The relationship between the dietary provision of α -tocopherol and the concentration of the vitamin in the semen of the chicken: effect on lipid composition and susceptibility to peroxidation. *Journal of Reproduction and Fertility*, **110**: 47-51.
9. MEZES M., SURAI P., SALYI G., SPEAKE B., GAAL T., MALDJIAN A. (1997) Nutritional metabolic diseases of poultry and the disorders of the biological antioxidant defence system. *Acta Veterinaria Hungarica*, **45**: 349-360.
10. SURAI P., KUCHMISTOVA E., SPEAKE B.K., BONDARENKO V. AND LISENKO S. (1997) Lipid peroxidation in avian embryonic tissues. *Biologicheskij Vestnik, Kharkov*, **1**: 12-22.
11. CEROLINI S., SURAI P., MALDJIAN A., GLIOZZI T., NOBLE R. (1997) Lipid composition of semen in different fowl breeders. *Poultry and Avian Biology Reviews*, **8**: 141-148.
12. SURAI P., IONOV I., KUKLENKO T., KOSTJUK I., MacPHERSON A., SPEAKE B., NOBLE R., SPARKS N. (1998) Effect of supplementing the hen's diet with vitamin A on the accumulation of vitamins A and E, ascorbic acid and carotenoids in the egg yolk and in the embryonic liver. *British Poultry Science*, **39**: 257-263.
13. SURAI P., IONOV I., KUCHMISTOVA E., NOBLE R., SPEAKE B. (1998) The relationship between the levels of α -tocopherol and carotenoids in the maternal feed, yolk and neonatal tissues: Comparison between the chicken, turkey, duck and goose. *Journal of the Science of Food and Agriculture*, **76**: 593-598.
14. SURAI P., CEROLINI S., WISHART G., SPEAKE B., NOBLE R., SPARKS N. (1998) Lipid and antioxidant composition of chicken semen and its susceptibility to peroxidation. *Poultry and Avian Biology Reviews*, **9**: 11-23.
15. SURAI P., KOSTJUK I., WISHART G., MacPHERSON A., SPEAKE B., NOBLE R., IONOV I., KUTZ E. (1998) Effect of vitamin E and selenium of cockerel diets on glutathione peroxidase activity and lipid peroxidation susceptibility in sperm, testes and liver. *Biological Trace Element Research*, **64**: 119-132.
16. SURAI P., BLESBOIS E., GRASSEAU I., GHALAH T., BRILLARD J-P., WISHART G., CEROLINI S., SPARKS N. (1998) Fatty acid composition, glutathione peroxidase and superoxide dismutase activity and total antioxidant activity of avian semen. *Comparative Biochemistry and Physiology*. **120B**: 527-533.
17. SURAI P.F., SPEAKE B.K. (1998) Distribution of carotenoids from the yolk to the tissues of the chick embryo. *Journal of Nutritional Biochemistry*, **9**: 645-651.

18. SURAI P.F. and SPEAKE B.K. (1998) Selective excretion of yolk-derived tocotrienols into the bile of chick embryo. *Comparative Biochemistry and Physiology*, **121B**: 393-396.
19. MALDJIAN A., CEROLINI S., SURAI P., SPEAKE B. (1998) The effect of vitamin E, green tea extracts and catechin on the in vitro storage of turkey spermatozoa at room temperature. *Poultry and Avian Biology Reviews*, **9**: 143-151.
20. SPEAKE B.K., DECROCK F., SURAI P.F., GROSCOLAS R. (1999) Fatty acid composition of the yolk lipids of a fish-eating bird, the Emperor Penguin (*Aptenodytes forsteri*). *Lipids*, **4**: 283-290.
21. SURAI P.F., SPEAKE B.K., NOBLE R.C. and SPARKS N.H.C. (1999) Tissue-specific antioxidant profiles and susceptibility to lipid peroxidation of the newly hatched chick.. *Biology Trace Element Research*, **68**: 63-78.
22. THOMPSON M.B., SPEAKE B.K., RUSSELL K.J., McCARTNEY R.J., SURAI P.F. (1999) Changes in fatty acid profiles and in protein, ion and energy contents of eggs of the Murray Short-Necked Turtle, *Emydura macquarii* (*Chelonia*, *Pleurodira*) during development. *Comparative Biochemistry and Physiology*, **122A**: 75-84.
23. SURAI P., SPEAKE B., NOBLE R., MEZES M. (1999) Species-Specific Differences in the Fatty Acid Profiles of the Lipids of the Yolk and of the Liver of the Chick. *Journal of the Science of Food and Agriculture*, **79**: 733-736.
24. SURAI P. (1999) Vitamin E in avian reproduction. *Poultry and Avian Biology Reviews*, **10**: 1-60.
25. ROYLE N.J., SURAI P.F., McCARTNEY R.J. and SPEAKE B.K. (1999) Parental investment and egg yolk lipid composition in gulls. *Functional Ecology*, **13**: 298-306.
26. SURAI P. (1999) Tissue-specific changes in the activities of antioxidant enzymes during the development of the chicken embryo. *British Poultry Science*, **40**: 397-405.
27. SURAI P.F., NOBLE R.C., SPEAKE B.K. (1999) Relationship between vitamin E content and susceptibility to lipid peroxidation in tissues of the newly hatched chick. *British Poultry Science*, **40**: 406-410.
28. THOMPSON M.B., STEWART J.R., SPEAKE B.K., RUSSELL K.J., McCARTNEY R.J., SURAI P.F. (1999) Placental nutrition in a viviparous lizard with a complex placenta. *Journal of Zoology, London* . **248**: 295-305.
29. SPEAKE B.K., SURAI P.F., NOBLE R.C., BEER J.V. AND WOOD N. (1999) Differences in egg lipid and antioxidant composition between wild and captive pheasants and geese. *Comparative Biochemistry and Physiology*, **124B**, 1: 101-107.
30. SURAI P.F., SPARKS N.H.C., NOBLE R.C. (1999) Antioxidant systems of the avian embryo: tissue-specific accumulation and distribution of vitamin E in the turkey embryo during development. *British Poultry Science*, **40**: 458-466.
31. THOMPSON M.B., SPEAKE B.K., STEWART J.R., RUSSELL K.J., McCARTNEY R.J., SURAI P.F. (1999) Placental nutrition in the viviparous lizard *Niveoscincus metallicus*: the influence of placental type. *Journal of Experimental Biology*, **202** (Pt 21):2985-2992.
32. CEROLINI S., MALDJIAN A., SURAI P., NOBLE R. (2000) Viability, susceptibility to peroxidation and fatty acid composition of boar semen during liquid storage. *Journal of Animal Reproduction Science*, **58**: 99-111.
33. SURAI P.F., BRILLARD J-P., SPEAKE B.K., BLESBOIS E., SEIGNEURIN F., SPARKS N.H.C. (2000) Phospholipid fatty acid composition, vitamin E content and susceptibility to lipid peroxidation of duck semen. *Theriogenology*, **53**: 1025-1039.
34. DORMAN D., SURAI P., DEANS S. (2000) In vitro Antioxidant Activity of a Number of Plant Essential Oils and Phytoconstituents. *Journal of Essential Oil Research*, **12**: 241-248.
35. SURAI P.F. (2000) Effect of the selenium and vitamin E content of the maternal diet on the antioxidant system of the yolk and the developing chick. *British Poultry Science*, **41**: 235-243.
36. SURAI P.F., MacPHERSON A., SEAKE B.K., SPARKS N.H.C. (1999) Designer egg evaluation in a controlled trial. *European Journal of Clinical Nutrition*, **54**: 298-305.
37. SURAI P.F., ROYLE N.J., SPARKS N.H.C. (2000) Fatty acid, carotenoid and vitamin A composition of tissues of free living gulls. *Comparative Biochemistry and Physiology*, **126A**: 387-396.
38. SURAI P.F., SPARKS N.H.C. (2000) Tissue-specific fatty acid and α -tocopherol profiles in the male chickens depending on dietary tuna oil and vitamin E provision. *Poultry Science*, **79**:1132-1142.
39. SURAI P.F., KUKLENKO T.V. (2000) Effects of vitamin A on the antioxidant systems of the growing chicken. *Asian-Australian Journal of Animal Sciences*, **13**: 1290-1295.
40. SURAI P.F., KUKLENKO T., IONOV I., NOBLE R. AND SPARKS N. (2000) Effect of vitamin A on antioxidant system of the chick during early post-natal development. *British Poultry Science*, **41**: 454-458.

41. MOLLER A.P., BIARD C., BLOUNT J.D., HOUSTON D.C., NINNI P., SAINO N. and SURAI P.F. (2000). Carotenoid-dependent signals: Indicators of foraging efficiency, immunocompetence or detoxification ability? *Poultry and Avian Biology Reviews*, **11**: 137-159.
42. SURAI P.F., NOBLE R.C., SPARKS N.H.C., SPEAKE B.K. (2000) Dietary supplementation of male chickens with oils rich in arachidonic or docosahexaenoic acids sustains spermatogenesis at 60 weeks of age. *Journal of Reproduction and Fertility*, **120**: 257-264.
43. SURAI P.F., CEROLINI S., SPEAKE B.K. (2000) Effect of supplementing the diet of male chickens with oils rich in n-6 polyunsaturated fatty acids on the fatty acid profiles of the testis and liver. *Asian-Australian Journal of Animal Sciences*, **13**: 1518-1522.
44. SURAI P.F., SPEAKE B.K., BORTOLOTTI G.R. and NEGRO J.J. (2001) Captivity Diets Alter Egg Yolk Lipids of a Bird of Prey, the American Kestrel, and of a Galliforme, the Red-Legged Partridge. *Physiological and Biochemical Zoology*. **74**(2):153-160 .
45. SURAI P.F. and SPARKS N.H.C. (2001) Comparative evaluation of the effect of two maternal diets on fatty acids, vitamin E and carotenoids in the chick embryo. *British Poultry Science* **42**: 252-259.
46. SURAI P.F., SPEAKE B.K., WOOD N.A.R., BLOUNT J.D., BORTOLOTTI G.R. and SPARKS N.H.C. (2001) Carotenoid discrimination by the avian embryo: A lesson from wild birds. *Comparative Biochemistry and Physiology* **128B**, **4**: 743-750.
47. SURAI P.F., SPEAKE B.K. and SPARKS N.H.C. (2001) Carotenoids in avian nutrition and embryonic development. 1. Absorption, availability and levels in plasma and egg yolk. *Journal of Poultry Science*. **38**: N1: 1-27.
48. SURAI P.F., SPEAKE B.K. and SPARKS N.H.C. (2001) Carotenoids in avian nutrition and embryonic development. 2. Antioxidant properties and discrimination in embryonic tissues. *Journal of Poultry Science*. **38**: N2: 117-145.
49. ROYLE N.J., SURAI P.F., HARTLEY I.R. (2001) Maternally derived androgens and antioxidants in bird eggs: complementary but opposing effects? *Behaviour Ecology* Vol. **12** No. **4**: 381-385
50. SURAI P.F., FUJIHARA N., SPEAKE B.K., BRILLARD J-P., WISHART G.J. and SPARKS N.H.C. (2001) Polyunsaturated Fatty Acids, Lipid Peroxidation and Antioxidant Protection in Avian Semen -Review- *Asian-Australian Journal of Animal Sciences* **17**, **7**: 1024-1050.
51. SPEAKE B.K., SURAI P.F., GORE M. (2001) Lipid Composition, Fatty Acid Profiles and Lipid-Soluble Antioxidants of Eggs of the Herman's Tortoise (*Testudo hermanni*). *Zoo Biology* **20** (2):75-87.
52. SURAI P.F. and SPARKS N.H.C. (2001) Designer eggs: from improvement of egg composition to functional food. *Trends in Food Science and Technology*. **12**: 7-16.
53. DVORSKA J.E. and SURAI P.F. (2001) Effects of T-2 toxin, zeolite and Mycosorb on antioxidant systems of growing quail. *Asian-Australian J. Anim. Sci.* **14**: 1752-1757.
54. SURAI P.F., BORTOLOTTI G.R., FIDGETT A., BLOUNT J. and SPEAKE B.K. (2001) Effects of piscivory on the fatty acid profiles and antioxidants of avian yolk: studies on eggs of the gannet, skua, pelican and cormorant. *J.Zool. Lond.* **255**: 305-312.
55. SURAI P.F., SPEAKE B.K., DECROCK F. and GROSCOLAS R. (2001) Transfer of Vitamins E and A from Yolk to Embryo during Development of the King Penguin. *Physiological and Biochemical Zoology* **74** (6): 928-936.
56. DVORSKA J.E., SURAI P.F., SPEAKE B.K. and SPARKS N.H.C. (2001) Effect of the mycotoxin aurofusarin on the fatty acid profile and antioxidant composition of quail eggs. *British Poultry Sci.* **42**: 643-649.
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59. BARTON N.W.H, FOX N.C., SURAI P.F. and SPEAKE B.K. (2002) Vitamins E and A, carotenoids and fatty acids of the egg yolk of raptors. *The Journal of Raptor Research* **36** (1): 33-38.
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61. SURAI P.F. (2002) Selenium in poultry nutrition: a new look at an old element. 1. Antioxidant properties, deficiency and toxicity. *World's Poultry Science Journal* **58**: 333-347.

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64. SURAI P.F. (2002) Selenium in poultry nutrition: a new look at an old element. 2. Reproduction, egg and meat quality and practical applications. *World's Poultry Science Journal* 58: 431-450.
65. HORAK P., SURAI P.F. and MOLLER A.P. (2002). Fat-soluble antioxidants in the eggs of great tits *Parus major* in relation to breeding habitat and laying sequence. *Avian Science* 2: 123-130.
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