

REFERENCES

- Abd El-Gawad, E. M. (1969). A preliminary study on the cost of rearing "Dokki-4" for meat production under local conditions. *Agricultural Research Review (Cairo, Egypt)* 47: 50-55.
- Abd El-Gawad, E. M. (1970). Heritability estimates and types of gene action of some economic traits in "Dokki-4". 2. Heritability and types of gene action on 8 and 12 week body weight. *Agricultural Research Review (Cairo, Egypt)* 48: 53-62.
- Abd El-Gawad, E. M. (1981). The 'Bandarah' a new breed of chickens. *Egyptian Poultry Science* 1: 16-22.
- Abd El-Gawad, E. M., and El-Ibiary, H. M. (1971). Heritability estimates of productive traits in Fayoumi, Leghorn and Rhode Island Red chickens. I. Body weight, shank length, rate of feathering and chick viability. *Agricultural Research Review (Cairo, Egypt)* 49(7): 69-77.
- Abd El-Gawad, E. M., and El-Ibiary, H. M. (1972). Predictability of broiler body weight from earlier weights in both Fayoumi and Rhode Island Red chickens. *Agricultural Research Review (Cairo, Egypt)* 50: 85-90.
- Abd El-Gawad, E. M., Khalil, A. Z., and Balat, M. M. (1979a). Genetic analysis of a new breed of chickens Mamourah. *Egyptian J. Genetics and Cytology* 8: 303-314. *Selection Evolution* 21, (2): 199-203 (A. B. A., 57: 6324).
- Abd El-Gawad, E. M., Madkour, M. H., Sayed, I. F., Mahmoud, T. H., and Balat, M. M. (1979b). A study on the performance of F1 crosses as compared with that of purebreds in chickens. 2. Body weight measurements, and feed conversion. *Agricultural Research Review (Cairo, Egypt)* 57(6): 99-107.
- Abd Ellatif, M. A. (1989). Genetic study on Dandarawy chickens. II. Heritability of live weight and carcass measurements. *Genetics Selection Evolution* 21(2): 199-203. (A. B. A., 57:6324).
- Abou El-Ella, N. Y. A. (1982). Genetic studies in Poultry. A comparative study on the performance potentiality of four locally develop strains and their F1 crosses. M. S. Thesis, Faculty of Agriculture, Alexandria University, Egypt.
- Aggrey, S. E., and Cheng, K. M. (1994). Animal model analysis of genetic (co) variances for growth traits in Japanese quail. *Poultry Science* 73(12): 1822-1828.
- Aggrey, S. E., and Cheng, K. M. (1995). Size of breeding populations required for selection programs. *Theor. Appl. Genet.* 91: 553-556.
- Ahlawat, S. P. S., Chaudhary, R. P., and Singh, B. P. (1980). Genetic and phenotypic correlations for some productive traits in the Babcock strain of White Leghorn. *Indian Poultry Gazette* 64: 28-34. (A. B. A., 49 : 2947).
- Aksoy, F. T. (1980). Genetic and phenotypic parameters of Lalahan New Hampshires in respect of body weight, egg production traits and estimations of a selection index. *Ankara University Veterinary Faktesi Dergisi* 27(314): 515-527. (A. B. A., 50: 5280).

- Al Sobayel, A. A. (1985). Studies on Saudi Arabian Baladi and SCW Leghorn: Effect of breed, hatching season and sex on body weight, growth rate and viability. *Egyptian Poultry Science* 5: 12-25.
- Al-Mufti, A. M. J. (1978). Improving broiler weight in the White Baladi chicken. M. Sc. Thesis, Faculty Agriculture, Cairo University, Egypt.
- Aman, N., and Becker, W. A. (1983). Genetic correlations between six- and seven-week-old broilers. *Poultry Science* 62(9): 1918-20.
- Amer, M. F. (1965). Heritability of body weight in Fayoumi. *Poultry Science* 44: 741-744.
- Amer, M. F., El-Ibiary, H. M., Khisin, S. S., and Issawi, H. F. (1964). A comparative study of Egyptian strains of chicken and three standard breed imported from Holland. II. Chick body weight at different ages. *Alexandria J. of Agriculture Research (Cairo, Egypt)* 12(12): 311-323.
- Amer, M. I. E. (1990). Environmental and genetic factors affecting productivity and quality of some strains of Fayoumi chickens. Ph. D. Thesis, Faculty of Agriculture, Zagazig University, Egypt.
- Asuquo, B. O., and Nwosu, C. C. (1987). Heritability and correlation estimates of body weight in the local chicken and their crosses. *East African Agriculture and Forestry J.* 52(4): 267-271. (A. B. A., 52: 6903).
- Atta, A. R. M. (1985). Physiological and economical differences between selected and non-selected White Baladi chicken line. M. Sc. Thesis, Faculty of Agriculture, Cairo University, Egypt.
- Awad, S. H. (1978). Selection for body weight in chickens. M. Sc. Thesis, Faculty Agriculture, Cairo University, Egypt.
- Ayoub, H., and Magraby, M. (1976). Heritability of the differences in body weight between sexes at different ages in poultry. *Agricultural Research Review (Cairo, Egypt)* 54: 37-42.
- Ayoub, H. E. (1965). Heritability of body weight at different ages in standard and local breeds of chicken and their crosses. M. Sc. Thesis, Faculty Agriculture, Ain-Shams University, Egypt.
- Barwal, R. S., Bhadula, S. K., and Singh, R. V. (1993). Construction of selection indices for genetic improvement in egg production traits in broiler dam line. *Indian J. Poultry Science* 28(1): 1-6.
- Beaumont, C. (1991). Comparison of Henderson's Method I and restricted maximum likelihood estimation of genetic parameters of reproductive traits. *Poultry Science* 70(7): 1462-1468.
- Beehan, D., and Ryan, E. (1989). Relationship between BLUP estimates for sire growth rate calculated from three alternative sources of progeny information. 40th Annual meeting of the European Association of Animal Production, Dublin, Ireland.
- Bernon, D. E., and Chambers, J. R. (1988). Genetic parameters of unadjusted and adjusted age-constant feed consumption and efficiency of meat type chickens. *Poultry Science* 67: 1497-1504.

- Besbes, B., Ducrocq, V., Foulley, J. L., Protais, M., Tavernier, A., Tixier, B. M., and Beaumont, C. (1992). Estimation of genetic parameters of egg production traits of laying hens by restricted maximum likelihood applied to a multiple-trait reduced animal model. *Genetics Selection Evolution* 24(6): 539-552.
- Bhushan, B., and Singh, R. V. (1995). Genetic studies on growth, feed conversion, body measurements and slaughter traits in sire line of broilers. *Indian J. Animal Sciences* 65(8): 935-938.
- Boldman, K. G., Kriese, L. A., Van Vleck, L. D., Van Tassell, C. P., and Kachman, S. D. (1995). *A manual for use of MTDFREML. A set of programs to obtain estimates of variances and covariances [DRAFT]*. U.S. Department of Agriculture, Agricultural Research Service, USA.
- Brody, S. (1945). *Bioenergetics and growth*. Reinhold Pub, Corp., New York.
- Brunson, C. C., George, F. G., and Goodman, B. L. (1956). Types of gene action in the inheritance of ten-week body weight and breast angle in broilers. *Poultry Science* 53: 524-532.
- Buvanendran, V. (1969). The heritability and genetic correlations of sexual dimorphism for 10-week weight in poultry. *British Poultry Science* 10: 321-325.
- Casanova, L., Hagger, C., Kuenzi, N., and Schneeberger, M. (1992). Inbreeding in Swiss Braunvieh and its influence on breeding values predicted from a repeatability animal model. *J. Dairy Science* 75(4): 1119-1126.
- Chambers, J. R. (1990). Genetic of growth and meat production in chicken., Ed. R. D. Grawford, In: *Poultry and genetics.*, Elsevier, Amsterdam, 599-644.
- Chambers, J. R., and Gavora, J. S. (1982). Genetic parameters of broiler traits in synthetic parent populations. *Poultry Science* 61: 1434-1435.
- Chambers, J. R., Wang, L., and McMillan, I. (1994). Genetic variation of broiler feed consumption and efficiency corrected for differences in test body weights. *Poultry Science* 73(8): 1196-1203.
- Cheong, I. C., Chung, S. B., and Park, Y. I. (1987). Studies on estimation of genetic parameters and selection index for hatching time, body weights and body measurements in maternal lines of broiler breeders, 1; estimation of heritability and genetic correlations. *Research Reports the Rural Development Administration Livestock and Veterinary* 29(1): 45-56.
- Chu, E., George, A., Liu, J., and Ng, E. (1984). *SPARSPAK: Waterloo sparse matrix package user's guide for SPARSPAKE-A*. CS-84-36, Dept. Computer Sci., Univ. Waterloo, Waterloo, ON., Canada (Agri. Res. Serv., USA, 1995).
- Clayton, G. A., and Robertosn, A. (1966). Genetic of changes in economic traits during the laying year. *British Poultry Science* 7: 143-151.
- Conkov, C., Cicibaba, V., Isaev, G., Ignatov, S., and Konova, E. (1970). Some genetic parameters in Cornish and White Plymouth Rock lines. *Genet. Selekt.* 3: 493-498. (A. B. A., 39: 3978).

- Danbaro, G., Oyama, K., Mukai, F., Tsuji, S., Tateishi, T., and Mae, M. (1995a). Heritabilities and genetic correlations from a selection experiment in broiler breeders using restricted maximum likelihood. *Japanese Poultry Science* 32(6): 257-266.
- Danbaro, G., Oyama, K., Mukai, F., Tsuji, S., Tateishi, T., and Mae, M. (1995b). Genetic trends from a selection experiment in broiler breeder lines using Best Linear Unbiased Prediction methodology. *Japanese Poultry Science* 32(6): 379-386.
- de Boer, I. J. M., and Hoeschele, I. (1993). Genetic evaluation methods for populations with dominance and inbreeding. *Theor. Appl. Genet.* 86(2-3): 254-258.
- Dempfle, L. and Senou, M. (1988). Faktoren fuer den Kurz- und langfristigen Selektionserfolg. Leipziger Tierzuchtsymposium, Karl-Marx-Universitaet, 8 und 9. Dez., Leipzig.
- Dickerson, G. E. (1962). Implications of genetic-environmental interaction in animal breeding. *J. Animal Production* 4: 47-64.
- Dieters, M. J., White, T. L., Littell, R. C., and Hodge, G. R. (1995). Application of approximate variance of variance components and their ratios in genetic tests. *Theor. Appl. Genet.* 91: 15-24.
- Ducrocq, V., Boichard, D., and Bonaiti, B. (1989). *Alternative strategy for solving the animal model equations for large data files.* 40th Annual Meeting of the European Association for Animal Production, Dublin, Ireland.
- Dunnington, E. A., and Siegel, P. B. (1996). Long-term divergent selection for eight-week body weight in White Plymouth rock chickens. *Poultry Science* 75(10): 1168-79.
- El-Deghadi, A. S. (1996). Genetic and phenotypic analysis for fur traits in rabbits. M. Sc. Thesis, Faculty of Agriculture, Moshtohor, Zagazig University, Egypt.
- El-Hossari, M. A. (1969). The Fayoumi domestic fowl. (D). Environmental effects on growth rate of chickens. *Agricultural Research Review (Cairo, Egypt)* 47: 56-79.
- El-Hossari, M. A. (1970a). The effect of selection for high body weight and high number on genetic and phenotypic variation in two strains of Fayoumi chickens. *U. A. R. Animal Production* 10(1): 55-63.
- El-Hossari, M. A. (1970b). The inheritance of growth characters in a Fayoumi flock. *Agricultural Research Review (Cairo, Egypt)* 48(1): 81-96.
- El-Hossari, M. A. (1971). The significance of covariance analysis of growth characteristics in Fayoumi chicken. *Agricultural Research Review (Cairo, Egypt)* 49(1): 93-101.
- El-Itriby, A. A., and Sayed, I. F. (1966). "Dokki-4" a new breed of poultry. *Agricultural Research Review (Cairo, Egypt)* 44: 102-109.
- El-Maghraby, M. M., and Bakir, A. A. (1977). Heritability of body weight at different ages in standard and local breeds of chickens. *Agricultural Research Review (Cairo, Egypt)* 55: 63-68.
- El-Maghraby, M. M., Madkour, Y. H., and Sayed, I. F. (1969). Effect of crossing Light Sussex and Australorp with Fayoumi on body weight. *Agriculture Research Review (Cairo, Egypt)* 58(6): 201-214.

- Everett, R. W., and Keown, J. F. (1984). Mixed model sire evaluation with dairy cattle: experience and genetic gain [Best linear unbiased prediction]. *J. Animal Science* 59(2): 529-541.
- Ezzeldin, Z. A. (1970). A study on the genetic parameters of body weight in the fowl. M. Sc. Thesis, Faculty Agriculture, Cairo University, Egypt.
- Fairfull, R. W., and Gowe, R. S. (1990). Genetic of egg production in chickens., Ed. R. D. by Grawford, In: Poultry and genetics., Elsevier, Amsterdam, 705-760 (*J. Anim. Sci.*, 1993, 71(1):57-65).
- Falconer, D. S. (1989). *Introduction to Quantitative Genetics*. "3rd Edition" Longman, London, UK.
- Falconer, D. S., and Mackay, F. C. (1996). *Introduction to quantitative genetics*. "4th edition" Longman Group Ltd, England.
- Famula, T. R. (1993). The contribution of progeny of uncertain paternity to the accuracy of sire evaluation. *J. Animal Science* 71(5): 1136-41.
- Farghaly, M. (1989). Heritability of specific gravity of live body weight and its relation with abdominal fat in chicken. *Egyptian Poultry Science* 9: 1-13.
- Farrag, A. Z. E. (1977). Effect of some environmental conditions on heritability and some other genetic-parameters in chickens. M. Sc. Thesis, Faculty Agriculture, Ain-Shams University, Egypt.
- Ferraz, J. B., and Johnson, R. K. (1993). Animal model estimation of genetic parameters and response to selection for litter size and weight, growth, and backfat in closed seedstock populations of large White and Landrace swine. *J. Animal Science* 71(4): 850-8.
- Foulley, J. L., Calomiti, S., and Gianola, D. (1982). Ecriture des equations du BLUP multicaracters. *Ann. Genet. Select. Anim.* 14: 309.
- Gebhardt-Henrich, S. G., and Marks, H. L. (1993). Heritabilities of growth curve parameters and age-specific expression of genetic variation under two different feeding regimes in Japanese quail (*Coturnix coturnix japonica*). *Genetic Research* 62(1): 45-55.
- George, A., Liu, J., and Ng, E. (1980). *User guide for SPARSPAK: Waterloo sparse linear equations package*. CS-78-30, Dept. Computer Sci., Univ. Waterloo, Waterloo, ON., Canada (Agri. Res. Serv., USA, 1995).
- George, A., and Ng, E. (1984). *A new release of SPARSPAK: The waterloo sparse matrix package*. Mimeo, Dept. Computer Sci., Univ. Waterloo, Waterloo, ON., Canada (Agri. Res. Serv., USA, 1995).
- Gerstmayr, S., Schlote, W., and Haussmann, H. (1989). *Estimation of variance components with an animal model including maternal effects*. 40th Annual Meeting of the European Association for Animal Production, Dublin, Ireland.
- Gianola, D., Foulley, I. L., and Fernando, R. L. (1986). Prediction of breeding values when variances are not known. *Genet. Sel. Evol.* 18(4): 485-498.
- Gill, H. S., and Varma, S. K. (1983). Genetic studies of growth in Columbian Plymouth Rock. *Indian J. Animal Science* 53: 172-174. (*A. B. A.*, 51: 5765).

- Gill, J. L. (1991). Biases in balanced experiments with uncontrolled random factors. *J. Anim. Breed. Genet.* 108: 69-79.
- Godfrey, G. F., and Goodman, B. L. (1956). Genetic variation and covariation in broiler body weight and breast width. *Poultry Science* 35: 47-50.
- Gomez-Raya, L., Schaeffer, L. R., and Burnside, E. B. (1992). Estimation of heritability in the base population when only records from later generations are available [genetic variance, linkage disequilibrium]. *Genetics Selection Evolution* 24(1): 19-27.
- Gong, B. (1992). [Iterative estimation of variance components for a mixed model with a numerator relationship matrix: apply to compute, K of variance ratio in BLUP and genetic parameters]. *J. Chuan Hsueh Pao* 19(5): 416-22.
- Gong, B. Y. (1989). [Study on BLUP with reduced animal model in evaluation of performance tested males]. *J. Chuan Hsueh Pao* 16(2): 125-39.
- Gonzalez, E., and Guerra, D. (1976). The heritability of body weight at 56 days of age in a meat-type line of fowls. *Revista Avicultura* 20: 161-166. (A. B. A., 45: 6276).
- Goodman, B. L. (1973). Heritabilities and correlations of body weight and dressing percentage in broilers. *Poultry Science* 52: 379-380.
- Goodman, B. L., and Godfery, G. F. (1956). Heritability of body weight in the domestic fowl. *Poultry Science* 35: 50-53.
- Goodman, B. L., and Jaap, R. G. (1960). Improving accuracy of heritability estimates from diallel and triallel mating in poultry. 1. Eight-week body weight in closed-flock strains. *Poultry Science* 39: 938-944.
- Groeneveld, E., and Brade, W. (1996). Pechentechnische Aspekte der multivariaten REML Kovarianzkomponentenschätzung dargestellt an einem Anwendungsbeispiel aus der Rinderzucht. *Arch. Tierz. Dummerstorf* 39(1): 81-87.
- Gupta, N. D., and Joahr, R. S. (1975). Early body weight of five strains of White Leghorn. *British Poultry Science* 16: 593-598.
- Gutierrez, J. P., Canon, J., and Rico, M. (1994). Comparison of two models for estimation of variance components in a sample of Spanish Holstein Friesians. *J. Anim. Breed. Genet.* 111(2): 169-174.
- Hagger, C. (1991a). Changes in (co)variance derived properties of animal model breeding values when offspring information became available in a selection experiment. *J. Anim. Breed. Genet.* 108(1): 1-8.
- Hagger, C. (1991b). Effects of selecting on phenotype, on index or on breeding value, on expected response, genetic relationships and accuracy of breeding values in an experiment. *J. Anim. Breed. Genet.* 108(2): 102-110.
- Hagger, C. (1992). Two generations of selection on restricted best linear unbiased prediction breeding values for income minus feed cost in laying hens. *J. Animal Science* 70(7): 2045-52.
- Haile-Mariam, M., and Philipson, J. (1996). Estimation of genetic and environmental trends of growth traits in Boran cattle. *J. Anim. Breed. Genet.* 113: 43-55.

- Hale, R. W. (1961). Heritabilities and genetic correlations of egg production and other characters in a White Wyandotte flock. *Animal Production* 33: 73-87.
- Hanafi, M. S., Khalil, M. H., Ezzeldin, Z. A., and Sabra, Z. A. (1991). Estimation of heterosis and combining abilities for body weights and measurements in chickens. *Egyptian J. of Animal Production* 28(2): 191-210.
- Harvey, W. R. (1979). Least-squares analysis of data with unequal subclass numbers. , United States Depart. Agri. Sci. and Education Administration, Agricultural Research Service, USA.
- Harvey, W. R. (1990) User's Guide for LSMLMW. Mixed model least squares and maximum likelihood computer program, PC-2 Version Edition. USA, Ohio, State University, Columbus (Mimeograph).
- Harville, D. A. (1977). Maximum likelihood approaches to variance component estimation and to related problems. *J. Amer. Stat. Assoc.* 72:320-340.
- Hazel, L. N., Dickerson, G. E., and Freeman, A. E. (1994). The selection index-then, now, and for the future. *J. Dairy Science* 77(10): 3236-51.
- Henderson, C. R. (1973). Sire evaluation and genetic trends. *Proceeding the Animal Breeding and Genet. symposium in Honour J. L. Lush*): pp. 10-41 (Cited from Mrode, 1996).
- Henderson, C. R. (1974). General flexibility of linear model techniques for sire evaluation. *J. Dairy Sci.*, 57:963-972.
- Henderson, C. R. (1975). Best linear unbiased estimation and prediction under a selection model. *Biometrics* 31(2): 423-47.
- Henderson, C. R. (1976). A simple method for computing the inverse of a numerator relationship matrix used in predicting of breeding values. *Biometrics* 32: 69-83 (Cited from Mrode, 1996).
- Henderson, C. R. (1984). *Applications of Linear Models in Animal Breeding*. University of Guelph Press, Guelph, Canada.
- Henderson, C. R., Kempthorne, O., Searle, S. R., and von Krosigk, C. N. (1959). Estimation of environmental and genetic trends from records subject to culling. *Biometrics* 15: 192.
- Henderson, C. R., and Quaas, R. L. (1976). Multiple trait evaluation using relative' records. *J. Animal Science* 43: 1188-1197 (Cited from Mrode, 1996).
- Hill, W. G. (1978). Design of selection experiments for comparing alternative testing regimes. *Heredity* 41(371-376 (Theor. Appl. Genet., (1995) 91: 553-556).
- Hinkelmann, K. (1969). Estimation of heritability from experiments with related dams. *Biometrics* 25: 755-766.
- Hinkelmann, K. (1971). Estimation of heritability from experiments with inbred and related individuals. *Biometrics* 27: 183-190.
- Hofer, A. (1998). Variance components estimation in animal breeding: a review. *J. Anim. Breed. Genet.* 115: 247-265.

- Hurry, H. F., and Nordskog, A. W. (1953). A genetic analysis of chick feathering and its influence on growth rate. *Poultry Science* 32: 18-25.
- Iraqi, M. M. (1991). Estimation of some phenotypic and genetic parameters on body weight of Dokki-4 chickens. M.Sc. Thesis, Faculty of Agriculture, Moshtohor, Zagazig University, Egypt.
- Ismail, I. H. (1980). Possibilities of indirect selection for some quantitative characters in poultry. M. Sc. Thesis, Faculty of Agriculture, Ain-Shams University, Egypt.
- Jaap, R. G., Smith, J. H., and Goodman, B. L. (1962). A genetic analysis of growth and egg production in meat-type chickens. *Poultry Science* 41: 1439-1446.
- Jensen, J., and Mao, I. L. (1991). Estimation of genetic parameters using sampled data from populations undergoing selection. *J. Dairy Science* 74(10): 3544-51.
- Jeyaruban, M. G., and Gibson, J. P. (1996). Estimation of additive genetic variance in commercial layer poultry and simulated populations under selection. *Theor. Appl. Genet.* 92: 3-4.
- Jeyaruban, M. G., Gibson, J. P., and Gowe, R. S. (1995). Comparison of index selection and best linear unbiased prediction for simulated layer poultry data. *Poultry Science* 74(10): 1566-76.
- Johnson, D. L., and Thompson, R. (1995). Restricted maximum likelihood estimation of variance components for univariate animal models using sparse matrix techniques and average information. *J. Dairy Science* 78: 449-456.
- Kataria, M. C., Sinha, S. P., and Johari, D. C. (1986). Short term-response to mass selection for eight week weight in three breeds of broilers. *Indian J. Poultry Science* 21(3): 219-222. (A. B. A., 55: 2581).
- Kemp, R. A., and Wilton, J. W. (1987). The effects of positive assortative mating and preferential progeny treatment on the estimation of breeding values. *J. Anim. Breed. Genet.* 104(4): 251-261.
- Kennedy, B. W. (1989). *Animal model BLUP - Crasms intensive graduate course*. University of Guelph, Dublin.
- Kennedy, B. W. (1991). C. R. Henderson: the unfinished legacy. *J. Dairy Science* 74(11): 4067-81.
- Kennedy, B. W., and Sorenson, D. A. (1988) Properties of mixed-model methods for prediction of genetic merit, ed. B. S. Weir, et al. Sunderland, USA, Sinauer Associates, Inc., pp. 91-103 (A.B.A. 57:03903).
- Khalil, M. H., Hanafi, M., El-Labban, A. E. F., and Iraqi, M. M. (1993). Genetic evaluation of growth traits in Dokki-4 chickens. *Egyptian J. Anim. Prod.* 30(2): 263-287.
- Khan, A. G., Poulose, M. V., Shrivastava, P. N., and Dutta, O. P. (1994). Heritabilities and genetic correlations for body weight in dwarf broilers. *Indian J. Animal Sciences* 64(12): 1383-1384.
- King, S. C., and Henderson, C. R. (1954). Variance components analysis in heritability studies. *Poultry Science* 33: 147-154.

- Knott, S. A., Sibly, R. M., Smith, R. H., and Moller, H. (1995). Maximum likelihood estimation of genetic parameters in life-history studies using the 'Animal Model'. *Functional Ecology* 9(1): 122-126.
- Koerhuis, A. N. M., and McKay, J. C. (1996). Restricted maximum likelihood estimation of genetic parameters for egg production traits in relation to juvenile body weight in broiler chickens. *Livestock Production Science* 46(2): 117-127.
- Koerhuis, A. N. M., and van der Werf, J. H. J. (1994). Uni- and bivariate breeding value estimation in a simulated horse population under sequential selection. *Livestock Production Science* 40(2): 207-213.
- Korhonen, T. (1996). "The dairy cattle evaluation of 1996". <http://www.mloy.fi/faba/blup/blup1.html>, 23.01.1997 (h: 14:13) (Article).
- Kosba, M. A., and Eid, S. M. (1983). Embryo and chick weight's heritabilities of the new Alexandria strains and the Fayoumi chickens. *Egyptian J. Genet. Cytol.* 12(1): 137-153.
- Kotby, E. A. (1958). Genetical and environmental factors affecting the growth in Fayoumi fowls. M. Sc. Thesis, Faculty Agriculture, Cairo University, Egypt.
- Kuhlers, D. L., and Mcdaniel, G. R. (1996). Estimates of heritabilities and genetic correlations between tibial dyschondroplasia expression and body weight at two ages in broilers. *Poultry Science* 75(8): 959-961.
- Kumar, A. S. (1979). Genetic studies of broiler traits in a strain of White Plymouth Rock. *Haryana Agriculture University* 5(1): 27-28. (A. B. A., 48: 43).
- Kumar, J., and Acharya, R. M. (1980). Genotypic and phenotypic parameters of growth and carcass yield of Desi chickens. *Indian J. Animal Science* 50: 509-513.
- Kumar, V. P., Khan, A. C., and Singh, A. (1988). Inheritance of body weights in meat type chickens. *J. Indian Veterinary* 65: 1142-1144.
- Laloe, D., Phocas, F., and Menissier, F. (1996). Considerations on measures of precision and connectedness in mixed linear models of genetic evaluation. *Genet. Sel. Evol.* 28: 359-378.
- Le Bihan-Duval, E., Beaumont, C., and Colleau, J. J. (1997). Estimation of the genetic correlations between twisted legs and growth or conformation traits in broiler chickens. *J. Anim. Breed. Genet.* 114: 239-259.
- Le Bihan-Duval, E., Mignon-Grasteau, S., Millet, N., and Beaumont, C. (1998). Genetic analysis of a selection experiment on increased body weight and breast muscle weight as well as on limited abdominal fat weight. *British Poultry Science* 39(3): 346-353.
- Ledur, M. C., Schmidt, G. S., Avila, V. S. d., Figueiredo, E. A. P., Munari, D. P., Correa Ledur, M., Silber Schmidt, G., Silveira de Avila, V., et al. (1992). Genetic and phenotypic parameters for body weight at different ages in broiler lines. *Revista da Sociedade Brasileira de Zootecnia* 21(4): 667-673.
- Lerner, I. M. (1958). *The Genetic Basis of Selection*. John Wiley and Sons, Inc., New York.

- Lien, S. (1973a). Genetic and phenotypic parameters for broiler weight, egg production and reproductive characters in White Plymouth Rocks. *Meldinger Fra Norges Landbrukshogskole* 52: 26. (A. B. A., 42: 3435).
- Lien, S. (1973b). Genetic and phenotypic parameters for live weight and some carcass quality characters in broiler. *Meldinger Fra Norges Landbrukshogskole* 52: 18. (A. B. A., 42: 4010).
- Liu, G., Dunnington, E. A., and Siegel, P. B. (1994). Responses to long-term divergent selection for eight-week body weight in chickens. *Poultry Science* 73: 1642-1650.
- Liu, G., Dunnington, E. A., and Siegel, P. B. (1995). Correlated responses to long-term divergent selection for eight-week body weight in chickens: Growth, sexual maturity, and egg production. *Poultry Science* 74: 1259-1268.
- Mayer, V. M., Stercken, R. C., and Simon, D. (1987). Schaetzung der Heritabilitaet aus Varianzkomponenten bei Verwandtschaft zwischen Eltern und bei gemeinsamer Umwelt. *J. Anim. Breed. Genet.* 104: 241-250.
- Mccartney, M. G. (1961). Heritabilities and correlations for body weight and conformation in a randombred population of Turkeys. *Poultry Science* 40: 1694-1700.
- Medrano, J. F., and Abplanalp, H. (1989). Prediction of selection response in asymmetrically distributed traits from selection components. *J. Anim. Breed. Genet.* 106(2): 110-119.
- Merritt, E. S. (1966). Estimates by sex of genetic parameters for body weight and skeletal dimensions in a random bred strain of meat type fowl. *Poultry Science* 45: 118-125.
- Meyer, K. (1989). Restricted maximum likelihood to estimate variance components for animal models with several random effects using a derivative-free algorithm. *Genetics Selection Evolution* 21(3): 317-340.
- Meyer, K. (1993) DFREML, Version 2.1 Edition, User notes.
- Meyer, K., and Thompson, R. (1984). Bias in variance and covariance component estimators due to selection on a correlated trait. *Z. Tierzuechtg. Zuechtgsbiol.* 101: 33-50.
- Mielenz, N., Groeneveld, E., Muller, J., and Spilke, J. (1994). Simultaneous estimation of variances and covariances using REML and Henderson 3 in a selected population of White Leghorns. *British Poultry Science* 35(5): 669-676.
- Mielenz, N., Van Arendonk, J., Spilke, J., and Schueler, L. (1996). Ueberlegenheit von BLUP bei der multivariaten Zuchtwertschaetzung in Gefluegelzuchtprogrammen - eine Monte-Carlo studie (Advantage BLUP for predicting breeding values in poultry breeding programs with multiple traits - a Monte-Carlo study). *Arch. Tierz., Dummerstorf* 39(1): 69-80.
- Misztal, I. (1990). Restricted maximum likelihood estimation of variance components in an animal model using sparse matrix inversion and a supercomputer. *J. Dairy Science* 73: 73-163.
- Misztal, I., Gianola, D., and Schaeffer, L. R. (1987). Extrapolation and convergence criteria with Jacobi and Gauss-Seidel iteration in animal models. *J. Dairy Science* 70(12): 2577-2584.

- Misztal, I., and Wiggans, G. R. (1988). Approximation of prediction error variance in large-scale animal models. *J. Dairy Science* 71(Suppl. 2): 27 (Br. Poul. Sci., (1994) 35(5):669-676).
- Morris, A. J., and Pollott, G. E. (1997). Comparison of selection based on phenotype, selection index and best linear unbiased prediction using data from a closed broiler line. *British Poultry Science* 38(3): 249-54.
- Mrode, R. A. (1996). *Linear models for the prediction of animal breeding values*. CAB International, Biddles Ltd, Guildford, UK.
- Muir, W. (1997). Genetic selection strategies: computer modeling. *Poultry Science* 76: 1066-1070.
- Nelder, J. A., and Mead, R. (1965). A simplex method for function minimization. *Computer J.* 7: 308 (Agri. Res. Serv., USA, 1995).
- Orozco, F. (1971). Genetic correlation between egg production and body weight and the coefficients of heritability for these characters in a strain of White Rock hens. *Serie General* 1: 141-154. (A. B. A., 42: 1937).
- Pang, H., Wu, C. X., Zhang, Y., Gong, G. F., and Bi, Y. H. (1989). [Animal model and multiple trait BLUP applied in poultry genetic evaluation]. *I. Chuan Hsueh Pao* 16(4): 291-8.
- Patterson, H. D., and Thompson, R. (1971). Recovery of inter-block information when block sizes are unequal. *Biometrika* 58: 454-554 (Br. Poul. Sci., (1994) 35(5):669-676).
- Peeler, R. J. G. E. W. B., W. L. (1955). The heritability of broiler weight and weight and age at sexual maturity and the genetic and environmental correlations between these traits. *Poultry Science* 34: 420-426.
- Pogutsa, N. (1991). Evaluation of breeding cocks. *Ptitsevodstvo* No. 10: 11-13.
- Pollak, E. J. (1992). "The animal model". http://www.inform.umd.edu/EdRes/Topic/AgrEnv/ndd/genetics/THE_ANIMAL_MODEL.html, 30.06.1997 (h: 18:51) (Article).
- Powell, J. C., and Bowman, J. C. (1964). An estimate of maternal effects in early growth characteristics and their effects upon comparative tests of chicken varieties. *British Poultry Science* 5: 121-132.
- Pribyl, J., and Pribylova, J. (1991). The use of BLUP method for the construction of selection indexes in egg-laying poultry. *Scientia Agriculturae Bohemoslovaca UVTIZ* 23(2): 135-144.
- Pribylova, J., Pribyl, J., Marvan, L., and Tyller, M. (1992). The use of animal model for a comparison of two successive generations of laying-type hens. *Scientia Agriculturae Bohemoslovaca* 24(1): 51-57.
- Pym, R. A. E., and Nicholls, P. J. (1979). Selection for food conversion in broilers: Direct and correlated response to selection for body-weight, gain, food consumption and food conversion ratio. *British Poultry Science* 20: 73-86.

- Quaas, R. L. (1976). Computing the diagonal elements and inverse of a large numerator relationship matrix. *Biometrics* 32: 949 (Agri. Res. Serv., USA, 1995).
- Quaas, R. L., Anderson, R. D., and Gilmour, A. R. (1984). *BLUP school Handbook - Use of mixed models for prediction and for estimation of (co)variance components*. Animal genetics and breeding unit, University of New England, N.S.W., 2351, Australia: 51 pp.
- Quinton, M., Smith, C., and Goddard, M. E. (1992). Comparison of selection methods at the same level of inbreeding. *J. Animal Science* 70(4): 1060-7.
- Raheja, K. L., and Singh, H. (1993). Relationships between estimates of sire's breeding value for growth and conformation traits in guinea fowl. *Indian J. Poultry Science* 28(3): 165-169.
- Ramappa, B. S., Lokanath, G. R., and Manjunath, V. (1986). Genetic parameters estimates of juvenile body weight in broiler parent lines. *Indian J. Poultry Science (A. B. A., 55: 2590)* 21: 170-175.
- Reddy, B. L. N., Sharma, R. P., Singh, B. P., Devroy, A. K., and Johari, D. C. (1997). Evaluation of genetic parameters of economic broiler traits in sire and dam populations. *Indian J. Poultry Science* 32(1): 33-38.
- Reddy, C. O., and Patro, B. N. (1983). Inheritance of bi-weekly body weight in new Hampshire chicken. *Indian Veterinary J.* 60: 999-1002. (A. B. A., 52: 5507).
- Renwick, G. M., Washburn, K. W., and Lanza, G. M. (1985). Genetic variability in growth response of chicks to cold brooding temperature. *Poultry Science* 64: 785-788.
- Rose, J., Iype, S., and Venugopalan, C. K. (1984). Inheritance of chick weight and egg production White Leghorn. 2. Heritability estimates. *Kerala J. Veterinary Science* 15: 21-28. (A. B. A., 54: 2503).
- Sabra, Z. E. (1990). Estimation of heterosis and combining abilities for some economic traits in chickens. M. Sc. Thesis, Faculty of Agriculture, Moshtohor, Zagazig University, Egypt.
- Sabra, Z. E. (1998). Genetic evaluation for sires and dams in rabbits. Ph.D. Thesis, Faculty of Agriculture, Moshtohor, Zagazig University, Egypt.
- Sabri, H. M. (1979). Genetical studies on meat characteristics in Fayoumi chickens. M. Sc. Thesis, Faculty of Agriculture, Cairo University, Egypt.
- Saeki, Y., and Akita, T. (1969b). Breeding chickens for meat production. VIII. Early growth rate and weight gain in selection for broiler weight. *Bull. Natn. Inst. Animal. Ind. Chiba* 21: 1-2. (A. B. A., 38: 4322).
- Saeki, Y., Akita, t., and Onishi, N. (1969a). Breeding chickens for meat production. VII. Age for efficient selection for rapid weight gain in broilers. *Bull. Natn. Inst. Anim. Ind., Chiba* 19: 53-61. (A. B. A., 38: 843).
- Samkari, M. K. (1962). Comparative study of some economical characteristics in Rhode Island Red, Fayoumi, Baladi and their crosses. M. Sc. Thesis, Faculty of Agriculture, Cairo University, Egypt.

- SAS. (1996). *SAS' Procedure Guide*. "Version 6.12 Ed." SAS Institute Inc., Cary, NC, USA.
- Schaeffer, L. R. (1993). *Variance component estimation methods*. University of Guelph, Guelph, Ontario.
- Schaeffer, L. R., and Kennedy, B. W. (1986). Computing strategies for solving mixed model equations. In: Annual Report, Centre for Genetic Improvement Livestock, Department Animal and Poultry Science, Ontario Agricultural College, University Guelph, 39.
- Schueler, L., Hempel, S., and Mielenz, N. (1996). Heritabilitätskoeffizienten und Maternaleffekte von Leistungsmerkmalen der Japanischen Wachtel (*Caturnix coturnix* Jap.). *Arch. Tierz., Dummerstorf* 39(6): 633-643.
- Scott, T. R., and Washburn, K. W. (1988). Genetic variation of plasma growth hormone and its genetic association with growth traits in young chickens. *Poultry Science* 67: 1781-1982.
- Searle, S. R. (1979). Notes on variance component estimation: A detailed account of maximum likelihood and kindred methodology. Paper BU-673-M, Biometrics Unit, Cornell University.
- Searle, S. R. (1989). Variance components-some history and a summary account of estimation methods. *J. Animal. Breed. Genet.* 106: 1-29.
- See, M. T., Mabry, J. W., and Bertrand, J. K. (1993). Restricted maximum likelihood estimation of variance components from field data for number of pigs born alive. *J. Animal Science* 71(11): 2905-9.
- Senou, M., and Dempfle, L. (1989). *Evolution of inbreeding, additive genetic variance and genetic progress in small nucleus breeding programs*. 40th Annual Meeting of the European Association for Animal Production, Dublin, Ireland.
- Shalash, S. M. M. (1977). Effect of crossbreeding on growth rate in chickens. M. Sc. Thesis, Faculty Agriculture, Ain-Shams University, Egypt.
- Sharara, H. H. (1974). Studies on some productive characters in different strains of chickens under upper Egypt condition. M. Sc. Thesis, Faculty of Agriculture, Assuit University, Egypt.
- Siegel, P. B. (1963a). Selection for breast angle at eight weeks of age. 2. Correlated responses of feathering, body weights and reproductive characteristics. *Poultry Science* 42: 437-449.
- Siegel, P. B. (1963b). Selection for body weight at eight weeks of age. 2. Correlated responses of feathering, body weights, and reproductive characteristics. *Poultry Science* 42: 896-905.
- Siegel, P. B., and Essary, E. O. (1959). Heritabilities and inter-relationships of live measurements and eviscerated weight in broilers. *Poultry Science* 38: 530-532.
- Singh, H. N., and Singh, B. P. (1979). Body weight inheritance in White Cornish chicks. *Veterinary Research Bulletin* 2: 28-31. (A. B. A., 48: 7550).

- Singh, H. N., and Singh, B. P. (1981). Inheritance of some economic traits in New Hampshire chickens. *Veterinary Research J.* 4: 141-144. (A. B. A., 51: 6762).
- Singh, H. N., and Singh, B. P. (1982). Genetic correlation and inheritance of the economic traits in White Cornish chickens. *Veterinary Research J.* 5(1): 22-27.
- Singh, H. N., and Singh, B. P. (1983). Inheritance of eight week body weight in pure and crossbred populations of two broiler breeds. *Indian Veterinary J.* 50: 560-563. (A. B. A., 52: 2903).
- Smith, E. J., and Savage, T. F. (1992). A comparison of four methods of variance component estimation for heritability of embryonic mortality in turkeys. *Poultry Science* 71(2): 229-234.
- Smith, J. H., and Jaap, R. G. (1957). Non-additive genetic effects on growth in a flock closed from crossbred parents. *Poultry Science* 35: 1158 (Abstract).
- Smith, S. R., and Graser, H.-U. (1986). Estimating variance components in a class of mixed models by restricted maximum likelihood. *J. Dairy Science* 69: 1156-1165 (Agri. Res. Serv., USA, 1995).
- Sorensen, D. A., and Johansson, K. (1992). Estimation of direct and correlated responses to selection using univariate animal models. *J. Animal Science* 70(7): 2038-44.
- Sorensen, D. A., and Kennedey, B. W. (1983). Estimation of genetic variance from selected and unselected populations. *J. Animal Science* 59: 1213-1223.
- Sorensen, D. A., and Kennedy, B. W. (1984). Estimation of genetic variances from unselected and selected populations. *J. Animal Science* 59(5): 1213-1223.
- Sorour, W. A. I. (1984). Genetic studies in poultry. M. Sc. Thesis, Faculty Agriculture, Zagazig University, Egypt.
- Southwood, O. I., Kennedy, B. W., Meyer, K., and Gibson, J. P. (1989). Estimation of additive maternal and cytoplasmic genetic variances in animal model. *J. Dairy Sci.* 72: 3006-3012.
- Spilke, J., Groeneveld, E., and Mielenz, N. (1993). Monte-Carlo simulation in variance-covariance component estimation in mixed linear multiple trait models. *Archiv fuer Tierzucht* 36(6): 679-686.
- Spilke, J., and Mielenz, N. (1992). The efficiency of multi-trait breeding estimation - a Monte-Carlo study in laying hens. *Archiv fuer Tierzucht* 35(5): 501-507.
- Stino, F. K. R., Awad, S. H., Ghani, M. A., and Khereldin, M. A. (1981). Body weights of a closed population of Cornish fowl II. Heritabilities. *Egyptian J. Animal production* 21: 183-190.
- Stino, F. K. R., Kamar, G. A. R., and Al-Mufti, A. M. J. (1983). Genetic and phenotypic correlation between eight-week body weight and related characteristics in White Baladi Chickens. *Egyptian J. Animal Production* 23: 127-132.
- Swinger, L. A., Harvey, W. R., Everson, D. O., and Gregory, K. E. (1964). The variance of intra-class correlation involving groups with one observation. *Biometrics* 20: 818-826.

- Szwaczkowski, T., and Wezyk, S. (1994). Estimation of the heritability of performance traits in laying hens by animal model - REML. *Roczniki Naukowe Zootechniki* 21(1-2): 33-39 (A. B. A. 63., 4677).
- Taylor, C. M., Gurung, B. S., and Vyas, R. (1973). Heritabilities of some of the economic traits in White Leghorn. *Gujvet* 7: 79-83. (A. B. A., 44: 5980).
- Thomas, C. H., Blow, W. L., Cockerham, C. C., and Glazener, E. W. (1958). The heritability of body weight, gain feed consumption, and feed consumption in broilers. *Poultry Science* 37: 862-869.
- Thompson, R. (1977). Estimation of quantitative genetic parameters. In: Pollak, E., Kempthorne, O. and Baiely, T. B. (eds) *Proceedings of the International Conference on Quantitative Genetics*, Iowa State University Press, Ames, pp. 639-657.
- Thompson, R. (1979). Sire evaluation. *Biometrics* 35: 339-353.
- Thompson, R., and Meyer, K. (1986). A review of theoretical aspects in the estimation of breeding values for multi-trait selection. *Livestock Production Science* 15: 299-313.
- Thompson, W. A. (1962). The problem of negative estimates of variance components. *Ann. Math. Stat.* 33: 273-289 (Animal breeding unit, University of New England, Australia, 1984).
- Toelle, V. D., Havenstein, G. B., Nestor, K. E., and Bacon, W. L. (1990). Estimates of genetic parameters in turkeys. 3. Sexual dimorphism and its implications in selection procedures. *Poultry Science* 69(10): 1634-1643.
- Toelle, V. D., Havenstein, G. B., Nestor, K. E., and Harvey, W. R. (1991). Genetic and phenotypic relationships in Japanese quail. 1. Body, weight, carcass, and organ measurement. *Poultry Science* 70(8): 1679-1688.
- Torres, R. D. A., Silva, M. D. A., Torres, J. R., and Soares, P. R. (1985). Genetic and phenotypic aspects of growth and production traits of light laying hens. *Revista Da Sociedade Brasileira De Zootecnia* 14: 383-394. (A. B. A., 54: 6245).
- Tosh, J. J., and Wilton, J. W. (1994). Effects of data structure on variance of prediction error and accuracy of genetic evaluation. *J. Animal Science* 72(10): 2568-2577.
- Tripathy, B. B., Patro, B. N., and Panda, G. M. (1984). Inheritance of juvenile body weight at different ages in a flock of White Cornish. *Avian Research* 68: 24-27 (A. B. A., 54: 3439).
- Turner, H. N., and Young, S. S. Y. (1969). *Quantitative genetics in sheep breeding*. "1st Ed." MacMill of Australia.
- Uimari, P., and Mantysaari, E. A. (1993). Repeatability and bias of estimated breeding values for dairy bulls and bull dams calculated from animal model evaluations. *Animal Production* 57(2): 175-182.
- van der Werf, J. H., and de Boer, I. J. (1990). Estimation of additive genetic variance when base populations are selected. *J. Animal Science* 68(10): 3124-32.

- van der Werf, J. H., and Thompson, R. (1992). Variance decomposition in the estimation of genetic variance with selected data. *J. Animal Science* 70(10): 2975-85.
- Van Tassell, C. P., Casella, G., and Pollak, E. J. (1995). Effects of selection on estimates of variance components using Gibbs sampling and restricted maximum likelihood. *J. Dairy Science* 78(3): 675-692.
- VanRaden, P. M., Jensen, E. L., Lawlor, T. J., and Funk, D. A. (1990). Prediction of transmitting abilities for Holstein type traits. *J. Dairy Science* 73(1): 191-7.
- VanRaden, P. M., and Wiggans, G. R. (1991). Derivation, calculation, and use of national animal model information. *J. Dairy Science* 74(8): 2737-46.
- Verma, S. K., Pani, P. K., and Mohapatra, S. C. (1983). Heritability for some economic traits in White Leghorn. *Indian J. Poultry Science* 18: 169-171. (A. B. A., 53: 454).
- Wang, L., Chambers, J. R., and McMillan, I. (1991a). Heritabilities of adjusted and unadjusted feed and abdominal fat traits in a broiler dam population. *Poultry Science* 70(3): 440-446.
- Wang, L. Z., McMillan, I., and Chambers, J. R. (1991b). Genetic correlations among growth, feed, and carcass traits of broiler sire and dam populations. *Poultry Science* 70(4): 719-25.
- Wei, M., and van der Werf, J. H. (1993). Animal model estimation of additive and dominance variances in egg production traits of poultry. *J. Animal Science* 71(1): 57-65.
- Wezyk, S., and Szwaczkowski, T. (1993). Animal Model as a tool for estimation of laying hen breeding value in Poland - Current possibilities and prospects. *Biuletyn Informacyjny. Instytut Zootechniki* 31(1-2): 3-14 (Biological Abstract, 97(5): 63361).
- Wiggans, G. R., and Misztal, I. (1987). Supercomputer for an animal model evaluation of Ayrshire milk. *J. Dairy Sci.* 70: 1906.
- Willham, R. L. (1972). The role of maternal effects in animal breeding III. Biometrical aspects of maternal effect in animals. *J. Animal Science* 35(6): 1288-1293.
- Willham, R. L. (1980). Problems in estimating maternal effects. *Livestock Production Science* 7: 405-418.
- Wood, C. M., Christian, L. L., and Rothschild, M. F. (1991). Use of an animal model in situations of limited subclass numbers and high degrees of relationships. *J. Animal Science* 69(4): 1420-7.
- Zhang, X., McDaniel, G. R., Yalcin, Z. S., and Kuhlers, D. L. (1995). Genetic correlations of tibial dyschondroplasia incidence with carcass traits in broilers. *Poultry Science* 74(6): 910-915.