Journal of Animal and Veterinary Advances 6 (9): 1101-1106, 2007
ISSN: 1680-5593

The Effects of Inclusion Different Levels of Dried Tomato Pomace in Laying Hens Diets on Performance and Plasma and Egg Yolk Cholesterol Contents

A. Nobakht and A.R. Safamehr
Department of Animal Science, Islamic Azad University Branch, Maragheh, Iran

Abstract: This study was designed to evaluate the effects of inclusion different levels of DTP pomace in laying hens diets on performance and serum and egg yolk cholesterol contents. One hundred eighty two Hy-Line strain laying hens, 65-73 weeks of age, were randomly assigned to 4 dietary treatments. The levels of DTP Inclusion were 0, 5, 7.5 and 10% and fed to laying hens for 8 week. Egg production, egg weight, egg mass and eggshell weight were significantly affected by inclusion of DTP in treatments. Whereas serum and egg yolk cholesterol content were not significantly affected ($p<0.05$). It was concluded that DTP can be used as an alternative feedstuff in laying hens diets, at inclusion levels up to 10% without negative effects on performance and egg quality.

Key words: Dried tomato pomace, performance, laying hens, egg yolk cholesterol, blood serum cholesterol

INTRODUCTION

Wet tomato pomace is product as a by- product of tomato juice manufacture (Cheeke, 1999) and contains 247 g kg^{-1} Dry Matter (DM, NRC, 1994). The wet tomato pomace, which amounts to 81000 tones annually in Iran, is considered waste and may cause serious environmental problems (Pirmohammadi *et al*., 2006). Increasing environmental concerns and legislation have promoted research into alternative methods of tomato waste disposal (Persia *et al*., 2003). From 1000 kg of fresh tomatoes, 100-300 kg wet tomato pomace are produced and normally disposed of being sold as anormal feedstuffs (Ben-Gera and Kramer, 1969) and its nutritional value is highly dependant on tomato cultivars, growing conditions, degree of drying and processing methods (Persia *et al*., 2003). Wet tomato pomace can be future dried to approximately 900 g kg^{-1} DM and because of its chemical composition, which possesses substantive nutritional value, can provide the poultry industry with an alternative feedstuff.

Tomato pomace is a mixture of tomato skin, pulp and crushed seeds that remain after the processing of tomato for juice, paste and/or ketchup. Bordowski and Geisman (1980) reported that tomato seeds protein contains approximately 13% more lysine than soy protein, which would allow it to be used in fortifying low lysine foods. Elloitt *et al*. (1981) demonstrated that Dried Tomato Pomace (DTP) is a good source of protein and the chemical composition of tomato cannery wastes suggests that they have the potential to be a good source of protein, but may be limited in energy due to the high fiber content.

In the recent years, people are becoming more and more health conscious and are preferring meat and egg with low cholesterol content. Efforts are being made to reduce the cholesterol content of egg and meat by feeding poultry with fiber rich diets and never feed ingredients with hypocholesterolemic activity. Tomato pomace is fiber rich feed resource and thought can be act as cholesterol reducing feedstuff in poultry product (Brodowski and Geisman, 1980).

The studies carried out by Frieman *et al*. (2000) indicated that the feeding of tomatoes reduced serum Low-Density Lipoprotein (LDL) cholesterol and triglyceride concentration in hamsters. Presanna Kumar *et al*. (1997) reported that tomato pectin decreased the plasma cholesterol in rats. Gerster (1997) reported that the red carotenoid pigment (lycopene) present in tomatoes has the cholesterol lowering effect. Kavitha *et al*. (2004) reported that the (DTP) inclusion up to 15% without enzyme supplementation in broiler diets reduce the serum and muscle cholesterol contents.

Regardless of the source, feeding fiber to laying hens also dilutes the available energy content of a diet and as a result, may limit energy intake and potentially reduce hepatic cholesterol production, especially if prior energy intake had been excessive (Naber, 1990). This may partially explain the observations of Weiss and Scott (1979) who fed laying hens diets containing 50% wheat

Corresponding Author: A. Nobakht, Department of Animal Science, Islamic Azad University Branch, Maragheh, Iran

bran, oat hulls, or alfalfa meal substituted isonitrogenously for part of the corn and soybean meal in the control diet and reported that yolk cholesterol contents were decreased by 19.8% (wheat bran), 16.2% (oat hulls) and 7.8% (alfalfa). Hen-day egg production rates were also greatly reduced in each of the fiber-supplemented groups (by 44.34 and 23%, respectively, from a control value of 84%), suggesting that the hens were severely energy deficient.

Although the effects of different dietary inclusion of DTP on performance and blood serum and egg yolk cholesterol content has not been studied in laying hens. The objective of this study was to evaluate the possibility of incorporation of DTP in laying hens performance and blood serum and egg yolk cholesterol contents.

MATERIALS AND METHODS

Hens and dietary treatments: One hundred and eighty two, 65 weeks old Hy-Line W36 laying hens obtained from a Company, were used in this study. These 182 hens were divided into 16 groups (each group containing 16 laying hens) in completely random design. Treatments were in a completely randomized design. The rations (Table 1) prepared for different experimental groups (n = 64) are summarized:

Group 1: Control diet without inclusion of DTP
Group 2: Basal diet containing 5% of DTP
Group 3: Basal diet containing 7.5% of DTP
Group 4: Basal diet containing 10% of DTP

All diets were in the meal form and based on corn and soybean meal. The diets were formulated to be isonitrogenous (15%) and isocaloric (2817 Kcal kg^{-1}) According the Hy-Line commercial management guide (2006- 2008) as fed basis. All diets have the same level of the amino acids lysine, methionine and tryptophan. During the experimental period, conventional management procedures were employed, natural and artificial light was provided for 16 h day^{-1}, ambient temperature was controlled and brides were fed and watered ad *libitum*. The birds were weighted at the commencement (65 week of age) and the end (73 week of age) of the trial.

Egg production (%hen-day) and egg weight (g) were recorded daily. Daily production was determined on a shelled egg weight basis. Feed intake (g/hen/day) was recorded weekly. Feed Conversion Ratio (FCR) was calculated as gram feed consumption per day per hen divided by gram egg mass per day per hen.

At the end of experiment 4 eggs per replicate (16 eggs per treatment) were individually weighed and the egg specific gravity (g mL^{-1}) was also evaluated. Eggshell weight and shell thickness were determined by randomly collecting 4 eggs from each replicate. After the eggs were broken the shells were washed and dried in room temperature for the determination of shell weight. The shell thickness was measured with a micrometer gauge (Measure, 24 21/1 type) on three part of shell from the eqator of each egg. These measurements were pooled.

Table 1: Composition of laying hen diets (as fed basis[1])

	DTP[2]			
	0	5	7.5	10
Ingredient composition(kg t^{-1})				
Corn grain	350	350	350	350
Tomato pomace	0	50	75	100
Soybean meal	201.4	179.2	168	156.7
?Wheat grain	265.9	247.5	238.3	229.1
Oil Vegetable	40	40	40	40
Oyster shell	92.2	92	91.9	91.8
Bone meal	17.3	17.2	17.1	17
Salt	3.5	3.3	3.2	3
Vitamin premix[3]	2.5	2.5	2.5	2.5
Mineral premix[3]	2.5	2.5	2.5	2.5
DL- Methionine (990 g kg^{-1})	1.3	1.2	1.2	1.2
Lysine	0.3	0.5	0.6	0.8
Chemical composition (g kg^{-1})				
Metabolizable energy(kcal kg^{-1})	2817	2817	2817	2817
Crude protein	150	150	150	150
Calcium	41	41	41	41
Avail. Phosphorus	3.4	3.4	3.4	3.4
Sodium	1.8	1.8	1.8	1.8
Lysine	7.4	7.4	7.4	7.4
Methionine	3.5	3.5	3.5	3.5
Tryptophan	2.9	2.9	2.9	2.9

[1]Dry matter content 900 g kg^{-1}. [2]DTP: Dried tomato pomace. [3]Premix supplied per kg of diet: 9000 IU vitamin A, 1.78 mg vitamin B_1, 6.6 mg vitamin B_2, 30 mg niacin, 10 mg pantothenic acid, 3 mg vitamin B_6, 0.15 mg biotin, 1500 mg choline, 0.015 mg vitamin B_{12}, 2000 IU vitamin D, 18 IU vitamin E, 2 mg vitamin K_3. [4]Premix supplied per kg of diet: 10 mg Cu, 0.99 mg I, 50 mg Fe, 100 mg Mn. 0.08 mg Se, 100 mg Zn

The shell weigh/area also recorded, and shell ash was determined after drying at room temperature for 3 days.

Yolk cholesterol, blood plasma cholesterol and Low Density Lipoprotein (LDL) were determined during the last week of the trial. Yolk cholesterol was extracted by the method of Folch *et al.* (1956) as modified by Washburn and Nix (1974) from 2 eggs of each replicate.

Blood samples from the brachial vein of two hens in each replicate, were drawn and centrifuged (3000×g for 15 min) immediately and plasma collected. Plasma and yolk cholesterol was estimated by the colorimetric Libermann-Burchard methods.

Statistical analysis: Data were analyzed by the General Linear models procedure of SAS Institute (1994). Means for treatments showing significant differences in the analysis of variance were compared using Duncan's multiple range tests. All statements of significance are based on the probability level of 0.05.

Table 2: Effects of different level of dried tomato pomace on laying hens performance

Treatments DTP (%)	Egg production (%)	Feed intake (g/hen/day)	Egg weight (g egg^{-1})	Egg mass (g/hen/day)	FCR (g feed g^{-1} egg)
0	61.81^{b}	117.34^{b}	62.78^{b}	40.93^{b}	2.86^{a}
5	66.03^{ab}	118.81^{ab}	64.25^{a}	42.28^{ab}	2.85^{a}
7.5	70.70^{a}	121.94^{a}	64.04^{a}	45.16^{a}	2.74^{a}
10	69.95^{a}	121.45^{a}	64.55^{a}	44.96^{a}	2.71^{a}
Pooled MSE	±1.91	±1.26	±0.41	±0.94	±0.06

^{a}Means within each column with different superscripts are significantly different (p<0.05)

Table 3: Effects of different level of dried tomato pomace on eggshell quality

Treatments	Specific gravity (mg cm^{-2})	Eggshell weight (g)	Eggshell thickness (mm)	Haugh unit	Shell weight/surface area (mg cm^{-2})
DTP (%)					
0	1.088^{a}	6.56^{ab}	0.340^{a}	80.3^{a}	79^{a}
5	1.086^{a}	7.15^{a}	0.333^{a}	77.59^{a}	77.59^{a}
7.5	1.077^{a}	6.19^{b}	0.304^{a}	85.74^{a}	85.73^{a}
10	1.076^{a}	6.68^{ab}	0.307^{a}	81.46^{a}	82.80^{a}
Pooled MSE	±0.0045	±0.221	±0.0043	±4.35	±3.52

^{a,b}ns within each column with different superscripts are significantly different (p<0.05)

Table 4: Effects of different levels of dried tomato pomace on blood plasma and egg yolk cholesterol

Treatments / DTP (%)	Egg yolk cholesterol (mg gr^{-1} yolk)	Plasma cholesterol (mg dL^{-1})	Plasma LDL (mg dL^{-1})
0	9.74^{a}	146.25^{a}	91.88^{a}
5	12.61^{a}	122^{a}	72.38^{a}
7.5	13.04^{a}	150.63^{a}	88.88^{a}
10	13.03^{a}	138.75^{a}	86.63^{a}
Pooled MSE	±.68	±.26	±041

Means within each column with same superscripts are not significantly different (p>0.05)

RESULTS AND DISCUSSION

The results for performance of laying hens are presented in (Table 2 and Fig. 1-4). At the end of experiment, final BW, FCR were similar among all treatments. However, egg weight, egg production, egg mass and daily feed consumption were higher (p<0.05) in treatments continent dried tomato pomace.

The results for egg quality of laying hens are presented in (Table 3 and Fig. 5). Between egg quality traits only eggshell weight affected significantly (p<0.05) by inclusion of DTP in laying hens diets. Inclusion DTP in diets had beneficial effects in eggshell weight and increased it. The results of blood plasma and egg yolk cholesterol contents are presented in (Table 4). Inclusion of dried tomato pomace in laying hens diets did not significantly (p>0.05) affected egg Yolk and blood plasma cholesterol.

Egg production rate and egg mass increased with inclusion the DTP levels up to 10%. Egg production rate and egg mass may be affected by supplying high levels of nutrients especially some amino acids like lysine with inclusion of DTP in laying hens diets. Bordoaski and Geisman (1980) reported that tomato seeds protein contains approximately 13% more lysine than soy protein. Elloitt *et al*. (1981) demonstrated that DTP is a good source of protein, which would allow it to use it as a protein supplement in low protein diets. Tomczynski (1978) showed that hens fed on diets containing tomato

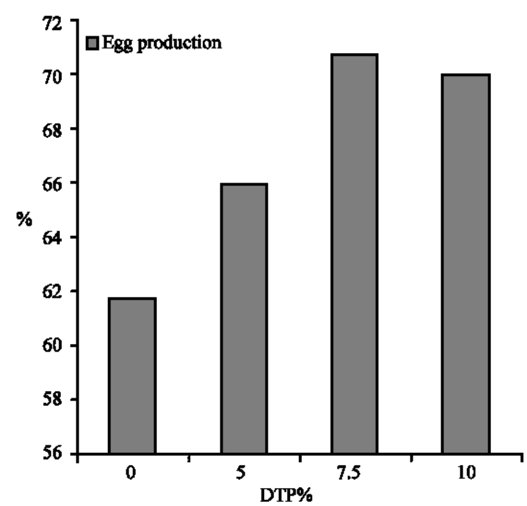

Fig. 1: Effects of different levels of DTP on Egg production rate

skins up to 7.17% had higher egg production than hens fed on a control diet. In contrast, Jafari *et al*. (2006) reported that in diets included 15% of DTP egg production and egg mass decreased. In our study, egg weight was affected by increasing level of DTP. DTP contains more lysine and egg weight can be affected by lysine contents of diets. In agreement with our result Yannakopoulos *et al*. (1992) found that tomato meal resulted in greater egg weight and suggested that this could be a consequence of its high lysine content.

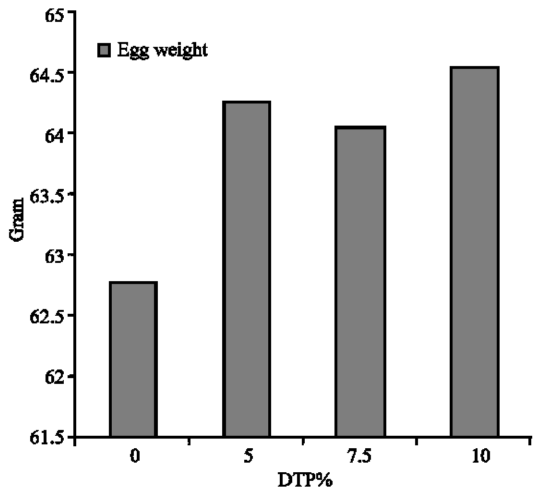

Fig. 2: Effects of different levels of DTP on Egg weight

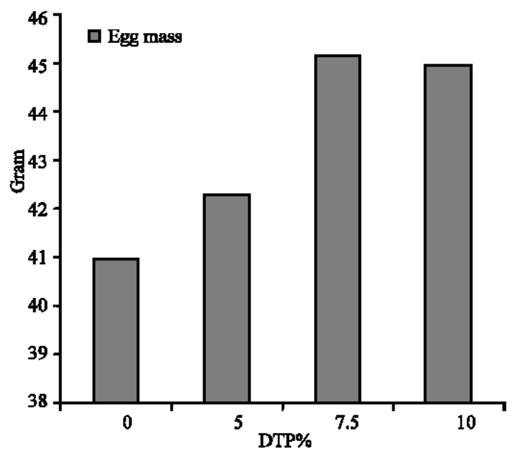

Fig. 3: Effects of different levels of DTP on egg mass

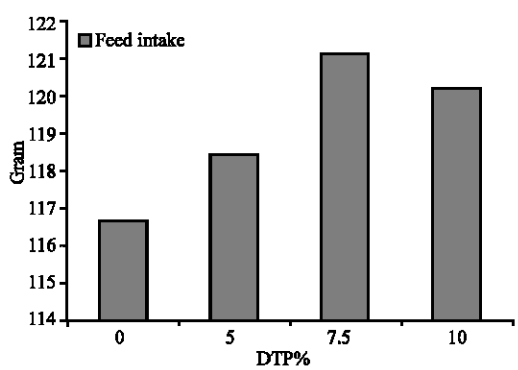

Fig. 4: Effects of different levels of DTP on daily feed intake

However, Jafari *et al*. (2006) reported that egg weight did not affected with inclusion TDP up to 15% in diets of laying hens. In this experiment feed consumption was

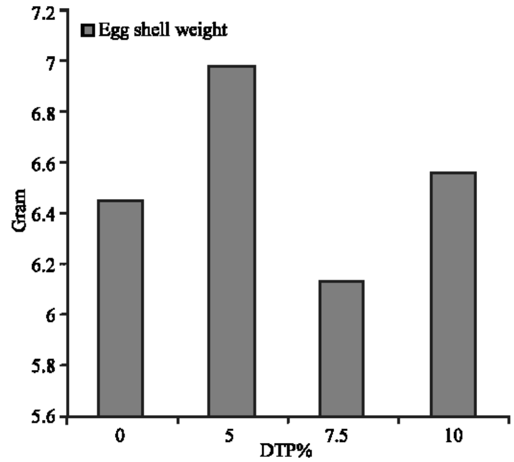

Fig. 5: Effects of different levels of DTP on eggshell weight

affected by feeding DTP. Feed consumption increased with increasing DTP in diets. Feed consumption may be affected by supplying balance diets with inclusion of DTP. However Al-Betawi (2005) reported that in broiler feed consumption not affected by inclusion of DTP up to 10% in its diets. Similar result was reported by Jafari *et al*. (2006) with inclusion of DTP up to 15% in laying hens diets. Moreover in our study feed efficiency was similar among treatments. In agreement with our results, Dotas *et al*. (1999) found that level up to 12% of DTP had no significant difference on feed efficiency.

Between egg quality only eggshell weight affected by inclusion of DTP in diets. It increased significantly with inclusion of 5% DTP in diets. Eggshell weight can be affected by high egg weight size that obtained by inclusion of DTP in diets. Whereas eggshell thickness decreased with increasing DTP in diets. In contrast, Gregoriades *et al*. (1984) found that the inclusion of DTP affected the shell thickness in layer diets. Moreover, there were no significant differences for Haugh units among treatments. This result confirms the effect that nutrition exhibits on Haugh units, something that has already been observed in previous studies (Lesson and Summers, 2001).

In this experiment plasma total cholesterol and LDL and yolk cholesterol not affected significantly by inclusion different levels of DTP in layer diets. However plasma cholesterol and LDL decreased by inclusion of DTP but yolk cholesterol increased. Meng *et al*. (1974) found that increasing the dietary fiber level from 4.1-17.7% with cellulose caused a reduction in serum cholesterol and an increase in egg yolk cholesterol. DTP contained high fiber this might have affected the absorption of cholesterol. Mouundras *et al.* (1997) reported that the plasma cholesterol lowering effect of crude fiber may be due to its ability to enhance fecal excretion of cholesterol and bile acids. Burr *et al.* (1985) reported a negative correlation between dietary fiber content and serum cholesterol. For decreasing significantly of plasma and yolk cholesterol contents may be needed inclusions high levels of DTP in laying hens diets and More researches should be done in this respect.

CONCLUSION

In conclusion inclusion of DTP at level up to 10% in diets of laying hens from 65-73 weeks of age improved performance and eggshell weight. Thus, DTP can be used as an alternative feedstuff in laying hens. Also inclusion DTP in laying hens diets has beneficial effects in lowering blood plasma and egg yolk cholesterol but there are not affected significantly by inclusion of DTP up to 10% in this experiment.

REFERENCES

Al-Betawi, N.A., 2005. Preliminary study on tomato pomace as unusual feedstuff in broiler diets. Pak. J. Nutr., 4: 57-63.

Ben-Gera, I. and A. Kramer, 1969. The utilization of food industries wastes. Adv. Food Res., 17: 77-135.

Bordowski, D.L. and J.R. Geisman, 1980. Protein content and amino acid composition of protein of seeds from tomatoes at various stages of ripeness. J. Food. Sci., 45: 228-235.

Burr, M.L., P.M. Sweetnam, M.E. Barasi and C.J. Bates, 1985. Correlation between dietary content and serum cholesterol in laying hens. Nutr. Res., 5: 465.

Cheeke, P.R., 1999. Applied Animal Nutrition: Feeds and Feeding. (2nd Edn.), Prented Hall, Englewood Cliffs, NJ, USA.

Dotas, D., S. Zamanidis and J. Balios, 1999. Effects of dried tomato pomace pulp on the performance and egg traits of laying hens. Br. Poul. Sci., 40: 695-697.

Elloitt, J., E. Mulvihill, C. Dumcan, R. Forsythe and D. Kritchevsky, 1981. Effects of tomato pomace and mixed vegetable pomace on serum and liver cholesterol in rats. J. Nutr., 111: 2203-2211.

Folch, J., M. Less and G.H. Solane Stanle,. 1956. A simple method for the isolation and purification of total lipid from animal tissues. J. Bio. Chem. 226: 497-509.

Friedman, M., T.E. Fitch and W.E. Yokoyama, 2000. Lowering of Plasma LDL cholesterol in hamsters by the tomato glycoallaloid tomatine. Food Chem. Toxic., 38: 549-553.

Gerster, H., 1997. The potential role of lycopene for human health. J. Am. College. Nutr., 16: 109-126.

Gregoriades, G.I., J.E. Madzaris and S.G. Moustakes, 1984. Feeding laying hens in groups on floor with diets containing dried tomato pulp. Agric. Res., 8: 75-82.

Hy-Line International Publication, 2006. Hy-Line variety W-36 commercial management guide 2006-2008. West Des Moines, Iowa U.S.A.

Jafari, M.R. Pirmohammadi and V. Bampidis, 2006. The use of dried tomato pulp in diets of laying hens. Int. J. Poul. Sci., 5: 618-622.

Kavitha, P., J.V. Ramana, J. Rama Prasad, P.S. Reddy and P.V.V.S. Reddy, 2004. Effects of dried tomato pomace inclusion in broiler diets on serum and muscle cholesterol content. XXII World's, Poultry, congress. Turkey.

Lesson, S. and J.D. Summers, 2001. Scott's Nutrition of the Chicken, (4th Edn.), Academic press. Guelph, Ontario, Canada, pp: 466-468.

Menge, H.L. Littlefield, L.T and B.T. Weinland, 1974. Effects of cellulose and cholesterol on blood and yolk lipids and reproductive efficiency of the hen. J. Nutr., 104: 1554-1556.

Moundas, C., S.R. Behar, C. Remensy and C. Demigne, 1997. Fecal losses of sterols and bile acids induced by feeding rats guar gum are due to greater pool size and liver bile acid secretion. J. Nutr., 127: 1068-1076.

Naber, E.C., 1990. Cholesterol content of egg: Can and should it be changed? Feedstuffs, 62: 47-52.

National Research Council, 1994. Nutrient requirements of poultry, (9th Rev. Edn.), National Academy Press, Washington DC, USA.

Persia, M.E., C.M. Schang and J. Azcona, 2003. Nutritional evaluation of dried tomato seeds. Poul. Sci., 82: 53-67.

Pirmohammadi, R., Y. Rouzbehan, K. Rezayazdi and M. Zahedifar, 2006. Chemical composition, digestibility and *in situ* degradability of dried and ensiled apple pomace and maize silage. Small Rum. Res. (in Press).

Presanna Kumar, G., Sudheesh, S. Ushakumari, B. Valsa kumar, A.K. Vijaykumar, S. Sandhra and N.R. Vijayalakshmi, 1997. A comparative study on the hypolpidemic activity of eleven different pectins. J. Food. Sci. Tech., 34: 103-107.

SAS Institute, 1994. SAS Users Guide: Statistics Version (6.12 Edn.), SAS Institute Inc., Cary, NC.

Tomczynski, R., 1978. Tomato seeds and skins for feeding of laying hens. Zeszyty Noukowe. Akademii Rolniczo-Technicznej w Olsztynie, 189: 153-164.

Washburn, K.W. and D.F. Nix, 1974. A rapid technique for extraction of yolk cholesterol. Poul. Sci., 53: 1118-1122.

Weiss, F.G. and M.L. Scott, 1979. Effects of dietary fiber, fat and total energy upon plasma cholesterol and other parameters in chickens. J. Nut., 109: 693-701.

Yannakopoulos, A.L., A.S. Tserveni-Gousi and E.V. Christaki, 1992. Effect of locally produced tomato meal on the performance and the egg quality of laying hens. Anim. Feed Sci. Tech., 36: 53-57.