1.	dp^{ov1}/dp^{ov1} ; $e(dp^{v})^{+}/e(dp^{v})^{+}$	females (79) 1.9	males (65) 2.3
2.	dp^{ov1}/dp^{ov1} ; $e(dp^{v})/e(dp^{v})^{+}$ -	females (23) 1.9	males (21) 2.6
3.	dp^{ov1}/dp^{ov1} ; $e(dp^{v})/e(dp^{v})$ -	females (53) 3.4	males (74) 3.4

Clearly, $e(dp^{v})$ also enhances the dumpy oblique phenotype as well, indicating the interaction is recessive for both mutants and taking place in both the developing wing disc and the tendon cells of the thoracic flight muscles. To date, the $e(dp^{v})$ gene, which maps at 40.4 on the third chromosome, has not been annotated nor has the lesion producing the dumpy interaction been identified.

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Temperature shock effects on *dumpy* wing expression.

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Introduction

The *dumpy* locus is a complex gene and developmental system. Through alteration of its' primary product, a large extracellular protein, three major mutant phenotypic effects have been noted. These are a truncated wing termed *oblique* (dp^{o}), a rearrangement of thoracic bristle pattern termed *vortex* (dp^{v}), and lethality (dp^{l}). Different *dumpy* alleles can exhibit a single one of these phenotypes or a combination, *e.g.*, both *oblique* and *vortex* (dp^{ov}). Phenotypic expression of *dumpy* can be modified by a number of genetic factors, among them are single second site enhancer or suppressor genes, *e.g.*, $en^{(dpv)}$, the accumulative effects of polygenic modifiers, and position effect. Not yet examined are the effects of environmental factors such as temperature shock during pupal development on the phenotypic expression of *dumpy* mutants in the adult fly. This approach was used in the 1960's in a number of studies on the genetics and development of the posterior crossvein (Thompson, 1967). In these studies both enhancement and suppression of the mutant phenotype, missing portions of the posterior crossvein, was dependent on the time during pupal development when heat shock was applied, age response, and the length of the heat shock treatment, dose response. This study shows that the wing phenotype of *dumpy-oblique* mutants can be altered by high temperature shock in a fashion similar to that observed with *crossveinless-like* mutants.

Materials and Methods

The four different *dumpy* mutations, dp^{ov1}, dp^{ov7b}, dp^{ov56a}, and dp^{ovA12}, used in this study are a part of the *dumpy* stocks maintained in the laboratory of Dr. Ross J. MacIntyre of Cornell University. Stocks were maintained on a standard medium at room temperature, 23°C. Experimental cultures were handled as described by Thompson (1967).

White prepupae were collected and placed on the inside walls of plastic shell vials (25 × 95 mm), plugged with moist cotton and allowed to continue development at 23°C. Whiteness of the prepupae indicates that it was collected in less than one hour after the onset of puparium formation, and the time of collection is

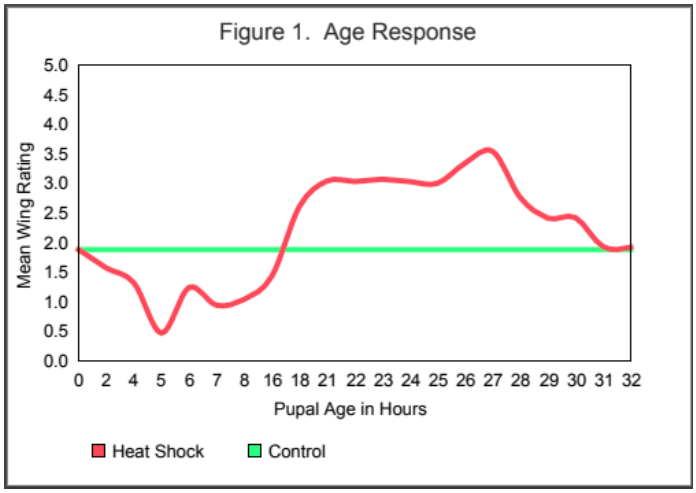
taken as time zero in pupal development. Temperature shocks were carried out in a constant temperature water bath set at 40.5°C by insertion of the collection vial into the water bath up to 15 mm of the plugged opening so that all collected pupae were treated but not submerged. After the pupae were subjected to treatment, the vials were removed from the water bath and pupae were allowed to complete development at 23°C until eclosion. In like manner, control samples were collected but were untreated and completed all development at 23°C.

Following eclosion, the treated and control flies were rated for wing length and appearance using the rating scale of 0 (wild-type) to 5 (extreme reduction in wing length and size) as described by Carmon *et al*. (2010). The average ratings of treated or control flies are presented as mean wing rating (mwr).

Three types of temperature shock experiments were performed. (1) Age Response: Pupae of the dp^{ov1} stock were collected over a range of developmental time from 2 through 32 hours and subjected to temperature shock for 20 minutes at 40.5°C. This stock was selected because of its moderate level of wing expression and because historically this was the first *dumpy* mutant described, originally as *truncate*, by Morgan and his colleagues at Columbia University in the famous "Fly Room" (Altenburg and Muller, 1920). The purpose of this type of experiment was first to determine if *dumpy* is temperature sensitive, secondly to determine if there are peak periods of sensitivity, and lastly to characterize the type of response(s). (2) Dose Response: Pupae of the dp^{ov1} stock were collected and at a peak response developmental age subjected to varying duration of temperature shock to determine the length of treatment for maximum response. (3) Comparative Response: Pupae of each of the *dumpy* stocks listed above were collected and treated at the peak response developmental ages for 20 minutes at 40.5°C. The purpose of this study was to determine whether the response to temperature shock is similar in all *dumpy oblique* mutations or if each reacts differently.

Results and Discussion

(1) Age Response: Figure 1 shows the combined female and male results of the age response study with dp^{ov1}. In this figure, the horizontal line represents the control level of expression with a mean wing rating of 1.88, and the curved line represents the heat shock responses. In addition to showing that *dumpy* is temperature sensitive, it clearly shows that dp^{ov1} has two major responses to temperature shock, an early suppression of the mutant effect and a later enhancement of the mutant effect. The early suppression occurs during the stage of development that Waddington (1940) characterized as the prepupal stage. The peak suppression response occurs at 5 hours of development with a mean wing rating of 0.47. The prepupal phase ends with the transition from prepupae to the pupal stage at 17 hours of development. This directly corresponds to Waddington's (1940) description of the prepupal to pupal transition point in development and is characterized with the eversion of the head of the developing fly. Enhancement begins with the start of the pupal stage at 18 hours of development and ends at 31 hours of pupal development. The peak enhancement response occurred at 26.5 hours of pupal development with a mean wing rating of 3.42.



(2) Dose Response: Figure 2 illustrates the Dose Response effect with dp^{ov1} pupae at 26.5 hours of development. In this figure, the curved line represents the expression (mwr) at varying lengths of heat shock. The response to varying treatment length shows a subthreshold response prior to 10 minutes and that treatment lengths from 10 to 20 minutes are linear in response after which time it plateaus. Thus, we concluded that 20 minutes is the optimum treatment time for maximum response. Dose response at the early suppression age of 5 hours also had a maximum response at 20 minutes of treatment.

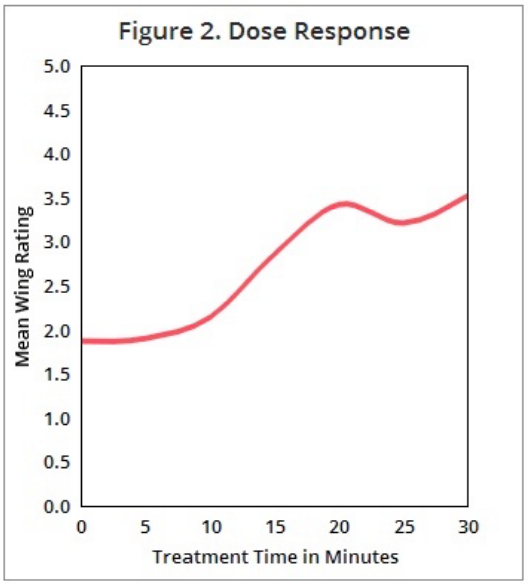


Table 1. Comparison of mean wing rating in dumpy-oblique mutants with Control (no treatment) and Heat Shock at 5 and 26.5 hours of pupal development. Values in parentheses are number of flies rated.

dumpy allele		Control (mwr)	5 Hour (mwr)	26.5 hour (mwr)
ov1	female	1.85 (255)	0.52 (126)	3.32 (244)
	male	1.90 (228)	0.42 (108)	3.55 (183)
ov7b	female	1.05 (64)	0.44 (34)	1.82 (66)
	male	0.60 (58)	0.10 (20)	1.52 (50)
ov56a	female	1.75 (149)	0.89 (35)	2.49 (126)
	male	1.45 (128)	0.60 (25)	2.06 (111)
ovA12	female	4.70 (146)	3.63 (52)	4.74 (77)
	male	4.74 (115)	3.67 (56)	4.46 (65)

(3) Comparative Response: Table 1 shows that all of the *dumpy-oblique* mutants tested have similar responses at both early (suppression) and late (enhancement) developmental ages as we have illustrated with dp^{ov1}. The exception to this conclusion being that 26.5 hour treatments with *dpovA12* do not show enhancement, but the phenotype of this mutant is so extreme, average mwr of 4.72, that it would be difficult to determine an enhancement effect with our method of scoring wing phenotype. This mutant does follow the pattern of suppression at 5 hours of development. Dose response studies at 5 hours of development with this extreme mutant follow the same pattern as seen with dp^{ov1} except that at high doses of heat shock, above 25 minutes, there is a reduction in viability.

This pattern of early suppression and later enhancement was also observed with the *crossveinless-like* studies of the 1960's (Thompson, 1967) with minor differences in timing. Whether this pattern applies to other wing mutations is unknown with the exception of an initial attempt to induce early suppression with *vestigial* which did not respond to 20 minute heat shock. It may be that moderate wing morphology mutations, for example *miniature*, and venation mutations such as *cubitus interruptus* and *abrupt* could be better candidates to respond to heat shock than the more extreme morphology changes seen with *vestigial*.

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Evaluation of the neuroprotective potential of aged garlic extract and grape flour in *Drosophila melanogaster*.

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Abstract

Oxidative stress is considered the main cause of aging and diverse neurodegenerative diseases, such as Alzheimer's, Parkinson's, and Huntington's. To decrease the number of these diseases, the antioxidant effects of many compounds have been explored. In this research, lines of *Drosophila melanogaster* were exposed to