

1 Notes

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3 **Tschinganine has different targets for chronological lifespan**
4 **extension and growth inhibition in fission yeast**

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19 **Running Head**

20 Chronological lifespan extension with Mochinganine

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22

23 **Abstract**

24 Tschimganine inhibits growth and extends the chronological lifespan in *Schizosaccharomyces pombe*.
 25 We synthesized a Tschimganine analog, Mochimganine, which extends the lifespan similar to
 26 Tschimganine but exhibits a significantly weaker growth inhibition effect. Based on the comparative
 27 analysis of these compounds, we propose that Tschimganine has at least two targets: one extends the
 28 lifespan, and the other inhibits growth.

29

30 **Keywords**

31 Tschimganine, Mochimganine, chronological lifespan, fission yeast

32

33 Tschimganine (TMN) is a compound originally extracted from *Ferula tschimganica* roots. It has
 34 been reported to exhibit estrogenic, insecticidal, and fungicidal activities (Nazrullaev et al. 2008; Zhou
 35 et al. 2018). Experiments with *Schizosaccharomyces pombe* fission yeast cells indicated that TMN acts
 36 to inhibit growth and extend the chronological lifespan (CLS), referring to the survival time of
 37 nondividing cells, and is considered a cellular lifespan model after the differentiation of higher
 38 organisms (Stephan et al. 2013; Hibi et al. 2018; Ohtsuka et al. 2021a). TMN was also extracted from
 39 the roots of *Ferula* plants, including *F. dissecta* and *F. szowitsiana*, as well as Iranian propolis
 40 (Sahranavard et al. 2009; Trusheva et al. 2010; Wang et al. 2014). Although potential TMN
 41 applications have been tested, including antitumor activity analysis (Sahranavard et al. 2009; Wang et
 42 al. 2014), not much is known about this compound.

43 In fission yeast, several compounds, including acivicin, 3,3'-diindolylmethane, mangosteen,
 44 monensin sodium, mycophenolic acid, nigericin sodium, prostaglandin J₂, wortmannin, ribozinindole-
 45 1, diazaborine, actinomycin D, 11 α OH-KA, and Torin 1, reportedly contribute to CLS extension, so
 46 does TMN (Stephan et al. 2013; Ohtsuka and Aiba 2017; Ohtsuka et al. 2017, 2021b; Hibi et al. 2018;
 47 Batubara et al. 2020; Rodríguez-López et al. 2020). TMN activates the stress-response mitogen-
 48 activated protein (MAP) kinase Sty1 and extends CLS in a Sty1-dependent manner (Hibi et al. 2018).
 49 Sty1, a homolog of the mammalian stress-activated MAP kinase p38, responds to various external
 50 stress stimuli, such as heat, osmotic, and oxidative stresses, and it plays significant roles in stress
 51 response, cell cycle, and starvation response, including autophagy (Yanagida et al. 2011;
 52 Bandyopadhyay et al. 2014; Shimasaki et al. 2014; Sjölander et al. 2020; Corral-Ramos et al. 2021). In
 53 addition, the protein kinase A (PKA) pathway is also involved in CLS regulation (Roux et al. 2009;
 54 Miwa et al. 2011; Ohtsuka et al. 2021c), and PKA inactivation, leading to the constitutive activation of
 55 Sty1, extends CLS in *S. pombe* (Zuin et al. 2010; Ohtsuka et al. 2021c). It remains unclear whether the
 56 PKA pathway is involved in the TMN-related CLS extension.

57 Two other TMN analogs, α -hibitakanine and β -hibitakanine, also extend CLS in a Sty1-dependent
 58 manner (Hibi et al. 2018). As these analogs sufficiently extend CLS with a relatively smaller growth-
 59 inhibiting effect compared with TMN, the two TMN-related CLS extension and growth inhibition
 60 phenotypes might involve different pathways, that is, TMN seems to have at least two different targets.

61 In this study, we successfully synthesized a new compound and named it Mochimganine (MMN),
 62 which is similar in structure to TMN and extends CLS with hardly inhibiting growth in *S. pombe*
 63 (Fig. 1a and S1). MMN is a compound in which TMN borneol is converted into cyclohexane. Although
 64 the TMN effect on cell growth largely depends on the concentration of the cell population, we
 65 investigated the half maximal inhibitory concentration (IC₅₀) on cell growth in *S. pombe*. When
 66 approximately 1.0×10^5 cells/mL were treated for 24 h, the TMN IC₅₀ was 2.5 mg/L (8.2 μ M), whereas
 67 that of MMN was 17.8 mg/L (71.1 μ M) (Fig. 1b). This result indicates that the MMN growth inhibition
 68 effect is significantly lower than that of TMN.

69 Next, we investigated how MMN affects CLS. The TMN treatment-mediated CLS extension is Sty1
 70 MAP kinase-dependent (Hibi et al. 2018). MMN drastically extends CLS in wild-type cells but less in
 71 Δ *sty1* mutants (Fig. 1c and 1d), suggesting that the MMN treatment-mediated CLS extension is
 72 partially Sty1 MAP kinase-dependent. As in fission yeast the Sty1 pathway is thought to be partially
 73 regulated by the PKA pathway (Zuin et al. 2010; Ohtsuka et al. 2021c), we investigated the CLS in the
 74 *pkal*-deletion mutant, lacking the gene that encodes a catalytic PKA subunit. Although Δ *pkal* cells
 75 have long CLS, however, further TMN- or MMN-mediated CLS extension could also be observed in
 76 the Δ *pkal* cells (Fig. 1d). These results suggest that PKA does not required for the CLS extension by
 77 TMN or its analog.

78 Both TMN and MMN extend CLS, but they affect growth inhibition very differently. To further
 79 elucidate the cellular effect-related differences, we comprehensively investigated transcripts when cells

80 were treated with each compound (Supplemental Table. 2). Furthermore, certain fluctuations in the
81 transcripts due to these drug treatments were confirmed by our real-time PCR assay (Fig. 2).

82 TMN not only causes Sty1-dependent CLS extension but also induces *ctt1*⁺ expression, encoding a
83 catalase (Hibi et al. 2018). MMN also induced *ctt1*⁺, but unlike TMN, the induction disappeared faster
84 (Fig. 2). TMN induced *hsp78*⁺, which is predicted to encode the mitochondrial heat shock protein, but
85 such MMN-mediated induction was significantly lower (Fig. 2), suggesting that TMN, unlike MMN,
86 has the potential to elicit an intracellular response. Consistent with this, the expressions of *lsd90*⁺,
87 which is known to extend CLS when overexpressed (Ohtsuka et al. 2021c), and *cbs2*⁺, encoding the
88 AMP-activated protein kinase (AMPK) γ -subunit (Forte et al. 2019), were also different following the
89 TMN or MMN treatment.

90 Due to the particularly large differences in the *hsp78*⁺ expression, we continued to investigate other
91 mitochondrial factors. We observed that TMN significantly changed the expression of mitochondria-
92 related factors compared with MMN. TMN induced *tps0*⁺, encoding a mitochondrial lipid translocator
93 protein affecting susceptibility to a fatty acid and sterol biosynthesis inhibitor, cerulenin (Jurkiewicz et
94 al. 2018), and *tpx1*⁺, encoding thioredoxin peroxidase (Shimasaki et al. 2014). By contrast, TMN, but
95 not MMN, suppressed the expressions of *cox7*⁺, which is predicted to encode a cytochrome c oxidase
96 subunit VII, and *tim18*⁺, which encodes the TIM22 inner membrane protein import complex anchor
97 subunit (Brault et al. 2016).

98 Moreover, the TMN treatment affected more significantly the expression of certain transporters
99 involved in nutrient uptake than the MMN treatment. TMN reduced the expression of *ght5*⁺, encoding a
100 plasma membrane high-affinity glucose/fructose protein symporter (Kurauchi et al. 2017), and *amt1*⁺,
101 encoding a plasma membrane ammonium transmembrane transporter (Brault et al. 2016).

102 Both TMN and MMN extend CLS at similar concentrations, but their growth-inhibiting effects are
103 completely different. In addition, the treatment with these agents resulted in significant differences in
104 the expressions of multiple genes. These results indicate that MMN is not a compound simply changed
105 by the biological activity of TMN but a compound that has largely lost its growth-inhibiting effect
106 among the two TMN functions.

107 The TMN treatment altered the expression of various mitochondrial genes, increasing that of *hsp78*⁺,
108 *tps0*⁺, and *tpx1*⁺ and decreasing that of *cox7*⁺ and *tim18*⁺. Although some genes are induced and others
109 are suppressed, their expression patterns are similar to those of gene expression regulation during
110 stress. *hsp78*⁺, *tps0*⁺, and *tpx1*⁺ are induced by H₂O₂, cadmium, or heat stresses, whereas *tim18*⁺ is
111 suppressed by H₂O₂ or cadmium stress (Chen et al. 2003). This similarity suggests that TMN affects
112 mitochondria and triggers the stress response.

113 TMN extended CLS in the Δ *pkal* mutant. This result indicated that TMN activates the Sty1 pathway
114 not mediated by PKA and contribute to CLS extension. In *Saccharomyces cerevisiae*, TMN does not
115 clearly extend CLS (Hibi et al. 2018). This might be due to Hog1, a Sty1 ortholog in *S. cerevisiae*,
116 which differently affects CLS depending on the conditions and does not contribute to CLS extension as
117 clearly as Sty1 (Santos et al. 2013; Garay et al. 2014; Ohtsuka et al. 2021c). Compared with TMN,
118 MMN induced weaker mitochondrial gene expression changes. However, as MMN-mediated CLS
119 extension sufficiently occurs, the mitochondrial gene expression fluctuation is not related to the CLS
120 extension by TMN and its analogs. This suggests that TMN significantly affects mitochondria in a CLS
121 regulation-independent manner.

122

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126

127 Data availability

128 The data underlying this article are available in the article and in its online supplementary material.

129

130 Author's contribution

131 H.O. and H.A. conceived and designed research; T.M., T.M., and T.S. performed research; H.O., T.M.,
132 T.M., and T.S. analyzed and interpreted the data; M.S. and Y.Y. synthesized and provided
133 Tschinganine and Mochinganine; and H.O. and H.A. wrote the paper. All authors approved the final
134 draft of the manuscript.

135

136 Conflict of interest

137 The authors declare no conflicts of interest with the contents of this article.

138

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205 Figures and Tables

206
 207 **Figure 1.** A Tschimganine derivative, Mochimganine, extends CLS but does not inhibit cell growth.
 208 (a) Tschimganine (TMN) and Mochimganine (MMN) structures. (b) TMN and MMN IC₅₀ values. (c)
 209 JY333 (WT) and JY333Δ*sty1* cells were cultured in synthetic dextrose (SD) with or without 2.5-mg/L
 210 TMN or MMN. Growth (left) and CLS (right) are shown (*n* = 3). (d) JY333 (WT) and JY333Δ*pkal*
 211 cells were cultured in SD with or without 2.5-mg/L TMN or MMN (*n* = 3). These strains are listed in
 212 Supplemental Table 1. The cells were grown in a SD medium supplemented with essential nutrients
 213 (Ohtsuka et al. 2019). The supplemental nutrient amounts were as follows: 40-μg/mL adenine and 60-
 214 μg/mL leucine. The cells were grown at 30°C. To measure survival, the cells were grown in SD media,
 215 sampled during each growth phase, and then plated on yeast extract (YE) agar plates after dilution.
 216 After 4–7 days of culture at 30°C, we counted the colony numbers in 1-mL culture aliquots on a plate
 217 and related to cell turbidity at each sampling time (Ohtsuka et al. 2017). Cell growth was then
 218 monitored according to turbidity determined using a Bactomonitor (BACT-550) equipped with a 600-
 219 nm filter (Nissho Electric). Data are expressed as average ± standard deviation.

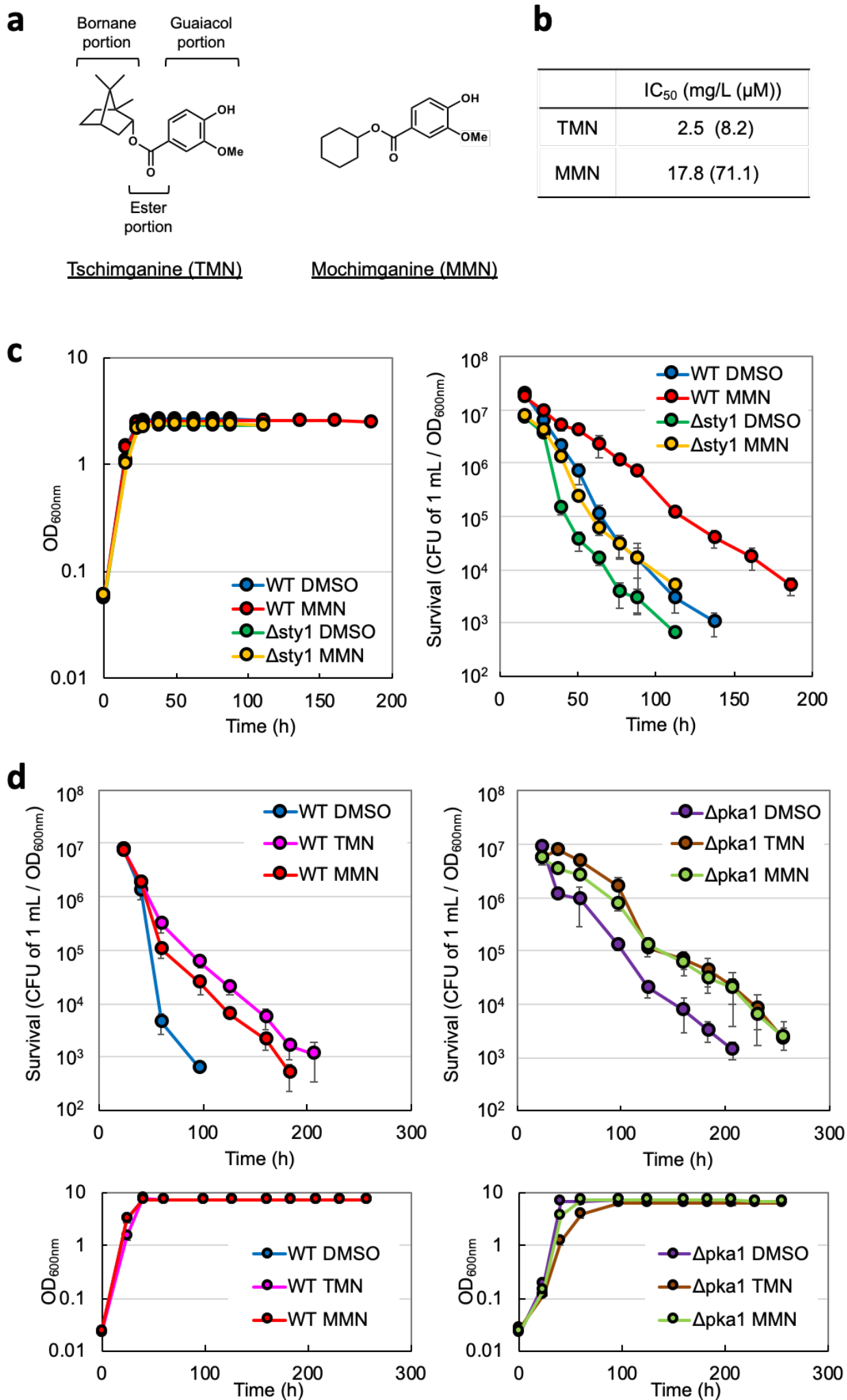
220
 221 **Figure 2.** Tschimganine causes transcriptional changes in the mitochondria and membrane transport
 222 proteins. JY1 cells were cultured in a SD medium and then transferred into a medium containing 5-
 223 mg/L Tschimganine and Mochimganine. The cells were harvested at 0, 20, and 60 min after the
 224 transfer, and the *ctt1*⁻, *hsp78*⁺, *lsd90*⁺, *cbs2*⁺, *tps0*⁺, *tpx1*⁺, *cox7*⁺, *tim18*⁺, *ght5*⁺ and *amt1*⁺-
 225 mRNA expressions were analyzed *via* real-time PCR assays (*n* = 3). Real-time PCR analysis was
 226 conducted as previously described (Ohtsuka et al. 2017), using the housekeeping gene *cdc2*⁺ as a
 227 control. The primers used in this study are listed in Supplemental Table 1. Data are expressed as
 228 average ± standard deviation.

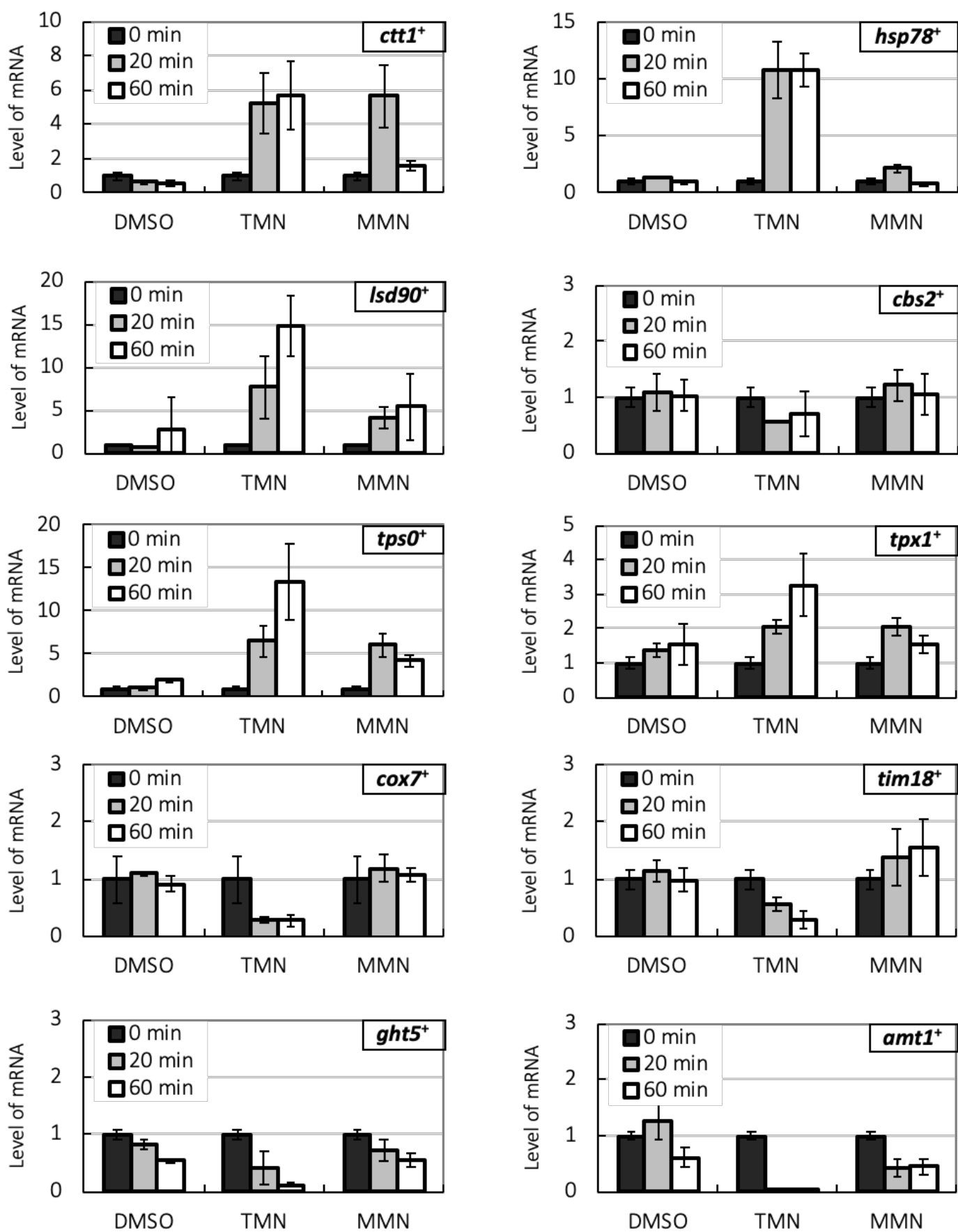
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 230 **Supplemental figure 1.** Mochimganine (MMN) was prepared as follow: the condensation of
 231 cyclohexanol and 4-benxyloxy-3-methoxy-benzoic acid using *N,N'*-Dicyclohexylcarbodiimide and
 232 CH₂Cl₂ afforded benzylated MMN in 52% yield. The subsequent hydrogenolysis of benzylated MMN
 233 using Pd/C as a catalyst under 1 atm hydrogen atmosphere in AcOEt produced MMN in 80% yield.
 234 The nuclear magnetic resonance (NMR) results for MMN. ¹H NMR (400 MHz, CDCl₃) δ 7.64 (dd, *J* =
 235 8.0, 2.0 Hz, 1H), 7.55 (d, *J* = 2.0 Hz, 1H), 6.93 (d, *J* = 8.0 Hz, 1H), 6.00 (s, 1H), 5.04–4.95 (m, 1H),
 236 3.95 (s, 3H), 1.98–1.89 (m, 2H), 1.84–1.74 (m, 2H), 1.64–1.52 (m, 3H), 1.50–1.30 (m, 3H); ¹³C NMR
 237 (100 MHz, CDCl₃) δ 166.8, 149.8, 146.1, 124.0, 123.2, 113.9, 111.7, 72.9, 56.1, 31.7, 25.5, 23.7; IR
 238 (neat, cm⁻¹) 3435, 1647; HRMS (ESI, *m/z*) Calcd. for C₁₄H₁₈O₄·H ([M+H]⁺): 251.1283, found
 239 251.1287.

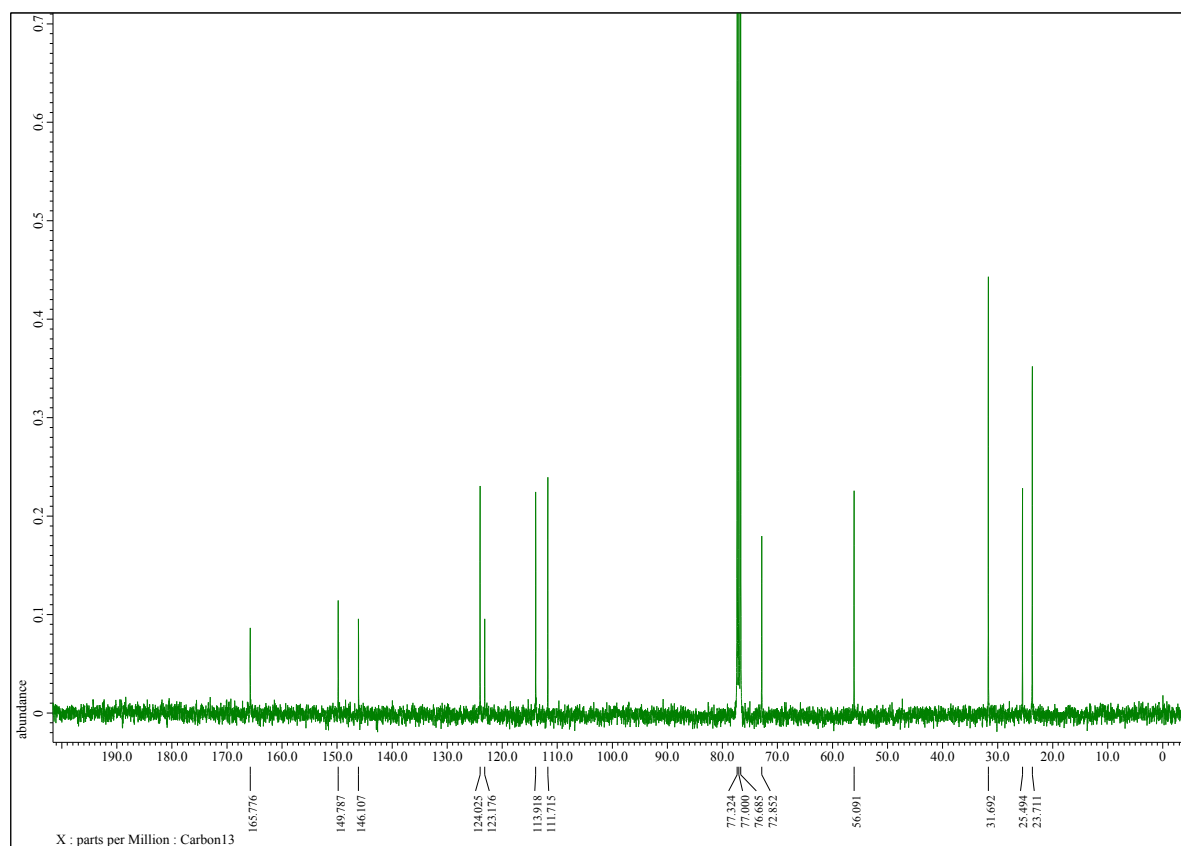
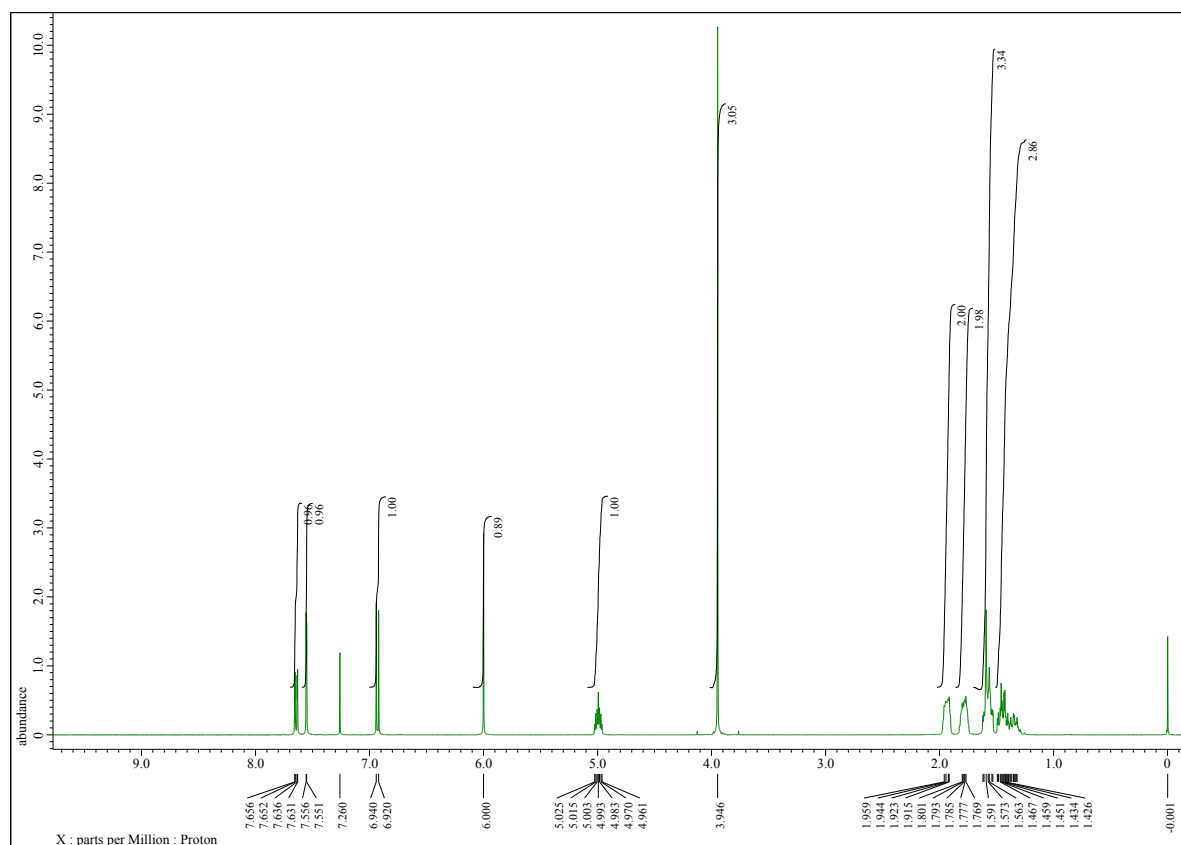
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 241 **Supplemental Table 1.** Strains and Primers

242
 243 **Supplemental Table 2.** RNA sequence data for all of the genes in fission yeast. JY1 cells were
 244 cultured in a SD medium and then transferred into a medium containing 5-mg/L Tschimganine and
 245 Mochimganine. The cells were harvested 60 min after the transfer. RNA sequence analyses were
 246 performed by BGI-Tech.

247







Supplemental Table 1 Strains and Primers**List of the fission yeast strains used in this study**

Strains	Genotype
<i>Schizosaccharomyces pombe</i>	
JY1	<i>h⁻</i>
JY333	<i>h⁻ leu1-32 ade6-M216</i>
JY333 Δ sty1	<i>h⁻ leu1-32 ade6-M216 sty1::kan^r</i>
JY333 Δ pka1	<i>h⁻ leu1-32 ade6-M216 pka1::kan^r</i>

Primers used in real-time PCR assay

Gene	Sequence
<i>ctt1⁺</i>	TTTTAACCCCTATGGCTGCGG ATGGACGACACGTTTCAGGAA
<i>cdc2⁺</i>	CCGAATTTTCAGAACTGGGG GTATAGTTCCGCAAAGGGAC
<i>hsp78⁺</i>	GGAGCCGCTTTGGAAGAATATGGC CTACACCAGCCGGACCAACTAAC
<i>lsd90⁺</i>	GCGCTAAGGAAACCGCCCAA CGCCGTCATTAGCGGTGTTG
<i>cbs2⁺</i>	GCGGGCCTTTTAACGATGGC GGCGCCAATCTTTCTTTCCAC
<i>tps0⁺</i>	CACTAGCATCTCCAAAATTGGTGGTC GCTGGTCCAAAGGCAGATGC
<i>tpx1⁺</i>	GGCCGACCCTAGCCATAAGG GGGCAAACCTCACCGTGCTC
<i>cox7⁺</i>	CGCTTTCTCCAAAGCATCCACAAACC CCCGAAAATGACTCTTCCAGAGGC
<i>tim18⁺</i>	CACGTTTAGGACTTGGAGCA TAATACCCTCCGTAAGGCCA
<i>ght5⁺</i>	GACCATTGTCATGTTGGTCTTCG CGCGCCGAAGAATACGAATACG
<i>amt1⁺</i>	CGCCATTGTTGCCTTTCAGTG CGGCAAACATACCTTGGAACAC

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Table with multiple columns and rows of data, including a header row and numerous data entries. The text is extremely small and dense.

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[The content of this table is extremely dense and illegible due to the high resolution and small font size. It appears to be a multi-column data table with numerous rows.]

Case No.	Date	Name	Address	City	State	Zip	Phone	Occupation	Education	Age	Sex	Marital	Religion	Political	Other
101	10/15/48	ALLEN, WALTER	1015 N. 1st St.	Omaha	Nebraska	68102	472-3456	Electrician	High School	38	M	M	Catholic	Dem.	
102	11/02/48	BROWN, JOHNSON	215 E. 1st St.	Omaha	Nebraska	68102	472-1234	Teacher	College	42	M	M	Methodist	Dem.	
103	11/10/48	SMITH, MARY	310 S. 3rd St.	Omaha	Nebraska	68102	472-5678	Homemaker	High School	35	F	M	Catholic	Dem.	
104	11/18/48	WILLIAMS, CAROL	415 N. 5th St.	Omaha	Nebraska	68102	472-9012	Librarian	College	28	F	S	Episcopal	Dem.	
105	12/01/48	JONES, ROBERT	515 N. 7th St.	Omaha	Nebraska	68102	472-3456	Engineer	College	45	M	M	Presbyterian	Dem.	
106	12/08/48	GARLAND, ELLIOTT	615 N. 9th St.	Omaha	Nebraska	68102	472-7890	Physician	College	52	M	M	Methodist	Dem.	
107	12/15/48	WATSON, ANN	715 N. 11th St.	Omaha	Nebraska	68102	472-1234	Retail	High School	31	F	M	Catholic	Dem.	
108	12/22/48	ANDERSON, DAVID	815 N. 13th St.	Omaha	Nebraska	68102	472-5678	Contractor	High School	36	M	M	Protestant	Dem.	
109	12/29/48	THOMAS, BETTY	915 N. 15th St.	Omaha	Nebraska	68102	472-9012	Secretary	High School	29	F	M	Catholic	Dem.	
110	1/05/49	PERKINS, RICHARD	1015 N. 17th St.	Omaha	Nebraska	68102	472-3456	Manager	College	41	M	M	Methodist	Dem.	
111	1/12/49	SCOTT, HELEN	1115 N. 19th St.	Omaha	Nebraska	68102	472-7890	Teacher	College	33	F	M	Catholic	Dem.	
112	1/19/49	GREEN, MICHAEL	1215 N. 21st St.	Omaha	Nebraska	68102	472-1234	Student	College	21	M	S	Protestant	Dem.	
113	1/26/49	BARNES, PATRICIA	1315 N. 23rd St.	Omaha	Nebraska	68102	472-5678	Homemaker	High School	26	F	M	Catholic	Dem.	
114	2/02/49	COOPER, ERNEST	1415 N. 25th St.	Omaha	Nebraska	68102	472-9012	Farmer	High School	58	M	M	Methodist	Dem.	
115	2/09/49	ROBERTS, LUCAS	1515 N. 27th St.	Omaha	Nebraska	68102	472-3456	Mechanic	High School	34	M	M	Catholic	Dem.	
116	2/16/49	HARRIS, VIVIAN	1615 N. 29th St.	Omaha	Nebraska	68102	472-7890	Retail	High School	24	F	M	Episcopal	Dem.	
117	2/23/49	CLARK, THOMAS	1715 N. 31st St.	Omaha	Nebraska	68102	472-1234	Engineer	College	47	M	M	Methodist	Dem.	
118	2/30/49	WALKER, ESTHER	1815 N. 33rd St.	Omaha	Nebraska	68102	472-5678	Homemaker	High School	30	F	M	Catholic	Dem.	
119	3/07/49	YOUNG, HAROLD	1915 N. 35th St.	Omaha	Nebraska	68102	472-9012	Teacher	College	37	M	M	Protestant	Dem.	
120	3/14/49	OLDHAM, JANE	2015 N. 37th St.	Omaha	Nebraska	68102	472-3456	Secretary	High School	27	F	M	Catholic	Dem.	
121	3/21/49	WOOD, GEORGE	2115 N. 39th St.	Omaha	Nebraska	68102	472-7890	Contractor	High School	44	M	M	Methodist	Dem.	
122	3/28/49	ATKINS, MARILYN	2215 N. 41st St.	Omaha	Nebraska	68102	472-1234	Retail	High School	23	F	M	Catholic	Dem.	
123	4/04/49	SMITH, ROBERT	2315 N. 43rd St.	Omaha	Nebraska	68102	472-5678	Engineer	College	49	M	M	Methodist	Dem.	
124	4/11/49	TURNER, ANNE	2415 N. 45th St.	Omaha	Nebraska	68102	472-9012	Homemaker	High School	32	F	M	Catholic	Dem.	
125	4/18/49	BROWN, JAMES	2515 N. 47th St.	Omaha	Nebraska	68102	472-3456	Teacher	College	39	M	M	Protestant	Dem.	
126	4/25/49	COOPER, MARY	2615 N. 49th St.	Omaha	Nebraska	68102	472-7890	Homemaker	High School	28	F	M	Catholic	Dem.	
127	5/02/49	PETERSON, JOHN	2715 N. 51st St.	Omaha	Nebraska	68102	472-1234	Manager	College	43	M	M	Methodist	Dem.	
128	5/09/49	SMITH, BETTY	2815 N. 53rd St.	Omaha	Nebraska	68102	472-5678	Retail	High School	25	F	M	Catholic	Dem.	
129	5/16/49	WALKER, CHARLES	2915 N. 55th St.	Omaha	Nebraska	68102	472-9012	Engineer	College	46	M	M	Protestant	Dem.	
130	5/23/49	ANDERSON, ELIZABETH	3015 N. 57th St.	Omaha	Nebraska	68102	472-3456	Homemaker	High School	31	F	M	Catholic	Dem.	
131	5/30/49	YOUNG, RICHARD	3115 N. 59th St.	Omaha	Nebraska	68102	472-7890	Student	College	22	M	S	Methodist	Dem.	
132	6/06/49	PERKINS, ANN	3215 N. 61st St.	Omaha	Nebraska	68102	472-1234	Secretary	High School	26	F	M	Catholic	Dem.	
133	6/13/49	GREEN, DAVID	3315 N. 63rd St.	Omaha	Nebraska	68102	472-5678	Teacher	College	38	M	M	Protestant	Dem.	
134	6/20/49	BARNES, MARY	3415 N. 65th St.	Omaha	Nebraska	68102	472-9012	Homemaker	High School	29	F	M	Catholic	Dem.	
135	6/27/49	COOPER, ERNEST	3515 N. 67th St.	Omaha	Nebraska	68102	472-3456	Farmer	High School	59	M	M	Methodist	Dem.	
136	7/04/49	ROBERTS, LUCAS	3615 N. 69th St.	Omaha	Nebraska	68102	472-7890	Mechanic	High School	35	M	M	Catholic	Dem.	
137	7/11/49	HARRIS, VIVIAN	3715 N. 71st St.	Omaha	Nebraska	68102	472-1234	Retail	High School	25	F	M	Episcopal	Dem.	
138	7/18/49	CLARK, THOMAS	3815 N. 73rd St.	Omaha	Nebraska	68102	472-5678	Engineer	College	48	M	M	Methodist	Dem.	
139	7/25/49	WALKER, ESTHER	3915 N. 75th St.	Omaha	Nebraska	68102	472-9012	Homemaker	High School	30	F	M	Catholic	Dem.	
140	7/31/49	YOUNG, HAROLD	4015 N. 77th St.	Omaha	Nebraska	68102	472-3456	Teacher	College	40	M	M	Protestant	Dem.	
141	8/07/49	OLDHAM, JANE	4115 N. 79th St.	Omaha	Nebraska	68102	472-7890	Secretary	High School	27	F	M	Catholic	Dem.	
142	8/14/49	WOOD, GEORGE	4215 N. 81st St.	Omaha	Nebraska	68102	472-1234	Contractor	High School	45	M	M	Methodist	Dem.	
143	8/21/49	ATKINS, MARILYN	4315 N. 83rd St.	Omaha	Nebraska	68102	472-5678	Retail	High School	24	F	M	Catholic	Dem.	
144	8/28/49	SMITH, ROBERT	4415 N. 85th St.	Omaha	Nebraska	68102	472-9012	Engineer	College	46	M	M	Protestant	Dem.	
145	9/04/49	TURNER, ANNE	4515 N. 87th St.	Omaha	Nebraska	68102	472-3456	Homemaker	High School	32	F	M	Catholic	Dem.	
146	9/11/49	BROWN, JAMES	4615 N. 89th St.	Omaha	Nebraska	68102	472-7890	Teacher	College	41	M	M	Protestant	Dem.	
147	9/18/49	COOPER, MARY	4715 N. 91st St.	Omaha	Nebraska	68102	472-1234	Homemaker	High School	28	F	M	Catholic	Dem.	
148	9/25/49	PETERSON, JOHN	4815 N. 93rd St.	Omaha	Nebraska	68102	472-5678	Manager	College	43	M	M	Methodist	Dem.	
149	10/02/49	SMITH, BETTY	4915 N. 95th St.	Omaha	Nebraska	68102	472-9012	Retail	High School	25	F	M	Catholic	Dem.	
150	10/09/49	WALKER, CHARLES	5015 N. 97th St.	Omaha	Nebraska	68102	472-3456	Engineer	College	47	M	M	Protestant	Dem.	
151	10/16/49	ANDERSON, ELIZABETH	5115 N. 99th St.	Omaha	Nebraska	68102	472-7890	Homemaker	High School	31	F	M	Catholic	Dem.	
152	10/23/49	YOUNG, RICHARD	5215 N. 101st St.	Omaha	Nebraska	68102	472-1234	Student	College	22	M	S	Methodist	Dem.	
153	10/30/49	PERKINS, ANN	5315 N. 103rd St.	Omaha	Nebraska	68102	472-5678	Secretary	High School	26	F	M	Catholic	Dem.	
154	11/06/49	GREEN, DAVID	5415 N. 105th St.	Omaha	Nebraska	68102	472-9012	Teacher	College	38	M	M	Protestant	Dem.	
155	11/13/49	BARNES, MARY	5515 N. 107th St.	Omaha	Nebraska	68102	472-3456	Homemaker	High School	29	F	M	Catholic	Dem.	
156	11/20/49	COOPER, ERNEST	5615 N. 109th St.	Omaha	Nebraska	68102	472-7890	Farmer	High School	60	M	M	Methodist	Dem.	
157	11/27/49	ROBERTS, LUCAS	5715 N. 111th St.	Omaha	Nebraska	68102	472-1234	Mechanic	High School	36	M	M	Catholic	Dem.	
158	12/04/49	HARRIS, VIVIAN	5815 N. 113th St.	Omaha	Nebraska	68102	472-5678	Retail	High School	26	F	M	Episcopal	Dem.	
159	12/11/49	CLARK, THOMAS	5915 N. 115th St.	Omaha	Nebraska	68102	472-9012	Engineer	College	49	M	M	Methodist	Dem.	
160	12/18/49	WALKER, ESTHER	6015 N. 117th St.	Omaha	Nebraska	68102	472-3456	Homemaker	High School	31	F	M	Catholic	Dem.	
161	12/25/49	YOUNG, HAROLD	6115 N. 119th St.	Omaha	Nebraska	68102	472-7890	Teacher	College	41	M	M	Protestant	Dem.	
162	12/31/49	OLDHAM, JANE	6215 N. 121st St.	Omaha	Nebraska	68102	472-1234	Secretary	High School	28	F	M	Catholic	Dem.	
163	1/07/50	WOOD, GEORGE	6315 N. 123rd St.	Omaha	Nebraska	68102	472-5678	Contractor	High School	46	M	M	Methodist	Dem.	
164	1/14/50	ATKINS, MARILYN	6415 N. 125th St.	Omaha	Nebraska	68102	472-9012	Retail	High School	25	F	M	Catholic	Dem.	
165	1/21/50	SMITH, ROBERT	6515 N. 127th St.	Omaha	Nebraska	68102	472-3456	Engineer	College	47	M	M	Protestant	Dem.	
166	1/28/50	TURNER, ANNE	6615 N. 129th St.	Omaha	Nebraska	68102	472-7890	Homemaker	High School	33	F	M	Catholic	Dem.	
167	2/04/50	BROWN, JAMES	6715 N. 131st St.	Omaha	Nebraska	68102	472-1234	Teacher	College	42	M	M	Protestant	Dem.	
168	2/11/50	COOPER, MARY	6815 N. 133rd St.	Omaha	Nebraska	68102	472-5678	Homemaker	High School	29	F	M	Catholic	Dem.	
169	2/18/50	PETERSON, JOHN	6915 N. 135th St.	Omaha	Nebraska	68102	472-9012	Manager	College	44	M	M	Methodist	Dem.	
170	2/25/50	SMITH, BETTY	7015 N. 137th St.	Omaha	Nebraska	68102	472-3456	Retail	High School	26	F	M	Catholic	Dem.	
171	3/03/50	WALKER, CHARLES	7115 N. 139th St.	Omaha	Nebraska	68102	472-7890	Engineer	College	48	M	M	Protestant	Dem.	
172	3/10/50	ANDERSON, ELIZABETH	7215 N. 141st St.	Omaha	Nebraska	68102	472-1234	Homemaker	High School	32	F	M	Catholic	Dem.	
173	3/17/50	YOUNG, RICHARD	7315 N. 143rd St.	Omaha	Nebraska	68102	472-5678	Student	College	23	M	S	Methodist	Dem.	
174	3/24/50	PERKINS, ANN	7415 N. 145th St.	Omaha	Nebraska	68102	472-9012	Secretary	High School	27	F	M	Catholic	Dem.	
175	3/31/50	GREEN, DAVID	7515 N. 147th St.	Omaha	Nebraska	68102	472-3456	Teacher	College	39	M	M	Protestant	Dem.	
176	4/07/50	BARNES, MARY	7615 N. 149th St.	Omaha	Nebraska	68102	472-7890	Homemaker	High School	30	F	M	Catholic	Dem.	
177	4/14/50	COOPER, ERNEST	7715 N. 151st St.	Omaha	Nebraska	68102	472-1234	Farmer	High School	61	M	M	Methodist	Dem.	
178	4/21/50	ROBERTS, LUCAS	7815 N. 153rd St.	Omaha	Nebraska	68102	472-5678	Mechanic	High School	37	M	M	Catholic	Dem.	
179	4/28/50	HARRIS, VIVIAN	7915 N. 155th St.	Omaha	Nebraska	68102	472-9012	Retail	High School	27	F	M	Episcopal	Dem.	
180	5/05/50	CLARK, THOMAS	8015 N. 157th St.	Omaha	Nebraska	68102	472-3456	Engineer	College	50	M	M	Methodist	Dem.	
181	5/12/50	WALKER, ESTHER	8115 N. 159th St.	Omaha	Nebraska	68102	472-7890	Homemaker	High School	32	F	M	Catholic	Dem.	
182	5/19/50	YOUNG, HAROLD	8215 N. 161st St.	Omaha	Nebraska	68102	472-1234	Teacher	College	42	M	M	Protestant	Dem.	
183	5/26/50	OLDHAM, JANE	8315 N. 163rd St.	Omaha	Nebraska	68102	472-5678	Secretary	High School	29	F	M	Catholic	Dem.	
184	6/02/50	WOOD, GEORGE	8415 N. 165th St.	Omaha	Nebraska	68102	472-9012	Contractor	High School	47	M	M	Methodist	Dem.	
185	6/09/50	ATKINS, MARILYN	8515 N. 167th St.	Omaha	Nebraska	68102	472-3456	Retail	High School	26	F	M	Catholic	Dem.	
186	6/16/50	SMITH, ROBERT	8615 N. 169th St.	Omaha	Nebraska	68102	472-7890	Engineer	College	48	M	M	Protestant	Dem.	
187	6/23/50	TURNER, ANNE	8715 N. 171st St.	Omaha	Nebraska	68102	472-1234	Homemaker	High School	34	F	M	Catholic	Dem.	
188	6/30/50	BROWN, JAMES	8815 N. 173rd St.	Omaha	Nebraska	68102	472-5678	Teacher	College	43	M	M	Protestant	Dem.	
189	7/07/50	COOPER, MARY	8915 N. 175th St.	Omaha	Nebraska	68102	472-9012	Homemaker	High School	30	F	M	Catholic	Dem.	
190	7/14/50	PETERSON, JOHN	9015 N. 177th St.	Omaha	Nebraska	68102									

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